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NEW OR NOTEWORTHY FUNGI FROM PANAMA AND COLOMBIA. III

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(WITH 18 FIGURES)

SCLEROCYSTIS COCCOGENA (Pat.) v. Höhn.

This species, heretofore known only from Martinique, was the second of two species included by Patouillard (Bull. Soc. Myc. Fr. **18**: 183. 1902) in his genus *Ackermannia,* the first being *A. Dussii,* from Martinique and Guadeloupe. Patouillard placed *Ackermannia* in the Ascomycetes near *Onygena,* regarding the long spores as asci. He noted, however, the resemblance to *Endogone* of which he suggested *Ackermannia* might be the perfect stage. Von Höhnel (Frag. 474. Sitzungsber. Akad. Wien Abt. 1. 119: 398. 1910) showed that the species of *Ackermannia* were congeneric with the earlier *Sclerocystis* Berk. & Br., based on an inadequately described species from Ceylon, and that they belonged in the Endogonaceae. Von Höhnel gives a brief review of the other pertinent literature, which need not be repeated here, and recognizes four species as included in the genus, one of which, *S. pubescens,* was later removed from it by Thaxter (Proc. Am. Acad. **57**: 291–341. 1922).

A single collection from Colombia (Hacienda Cincinnati above Santa Marta, Dept. Magdalena, 1250–1500 m. Aug. 22, 1935. G. W. M. *3609*) is the second record of the occurrence of this species and permits certain additions to the published descriptions.

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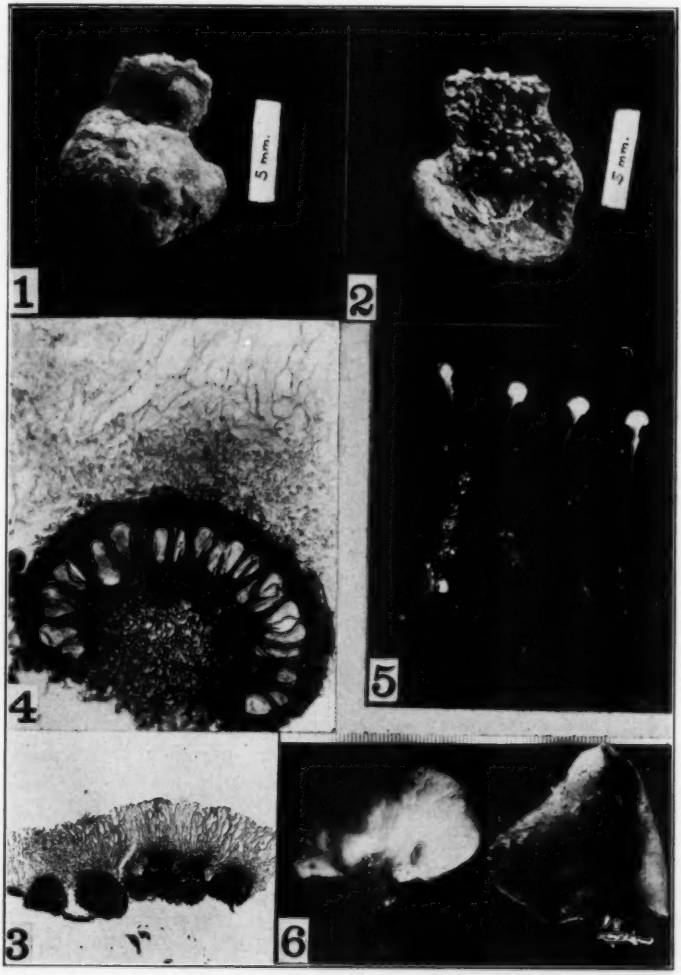
The stroma occurred on a dead twig, and was pure white when collected except for brownish stains where handled. It resembled nothing so much as a thick, fleshy cocoon enclosing a cluster of insect eggs. In drying, it became detached from the substratum and the color changed to a yellowish-brown, but the appearance remained essentially the same (FIGS. 1, 2). When dry, it measured 11 × 8.5 mm. The photographs were taken after a small piece had been cut from one end. A portion of this was soaked in lactic acid, imbedded in paraffin and sectioned and stained. Median sections through the sporocarps show the enormous, radially arranged spores arising from a columella-like center (FIG. 4) looking almost exactly like Thaxter's beautiful drawing of *S. Dussii* (his *pl. 4, fig. 83*). The spores, as measured in the sections, range from 63 to 89 μ in length and from 28 to 45 μ in width. Patouillard gives the dimensions as ± 100 × 60 μ, but it is evident that he did not see the septum just below the junction of the inflated portion and the stalk; at least these are not shown in his drawing of the same structures in *S. Dussii*. Thaxter says "about 100 × 40–50 μ." It seems probable that some allowance must be made for measurements made from sections, which can in few instances be strictly longitudinal and which may have been affected by the treatment to which they had been subjected. On the other hand, the spherical or oval chlamydospores mentioned by both authors as characteristic of the species, are larger than the dimensions, 25–30 μ, given by Patouillard, ten globose ones taken at random ranging from 26 to 39 μ in diameter. It is doubtful whether such differences are significant in this group, and in other respects the agreement is so striking as to leave little doubt of the correctness of the determination.

In summarizing the differences between *S. Dussii* and *S. coccogena*, Thaxter refers to "the apparent absence of a lysigenous pseudotissue of large, thin-walled hyphal segments" in the latter species. Thaxter's statement, expressed with characteristic caution, is undoubtedly to be attributed to the very scanty material available to him for examination, described as "a very small fragment." As reference to the illustration (FIG. 3) will show, this tissue is present in *S. coccogena* and is entirely comparable with that of *S. Dussii*.



FIGS. 1–4. *Sclerocystis coccogena*; 5, *Jola javensis*; 6, *Mycobonia flava*.

Several chlamydospores were noted in which the contents were separated into small, uniform aggregations of protoplasm, suggesting, but not satisfactorily demonstrating, that they were being transformed into sporangia.

Tulasnella sphaerospora sp. nov.

Late et interrupte effusa, tenuis, ceraceis, lilaceis, in sicco pallescente; probasidiis globosis, 11–14 μ diam.; epibasidiis globosis demum ovatis, apiculatis; basidiosporis globosis, (8–)10–12 μ diam.

Thin, tenuous, waxy, lilaceous-pink when fresh, drying to a dingy, whitish pruinose coating on the substratum and not recovering its color when soaked; hyphae short-celled, rather irregular, without clamp connections, 3–6 μ in diameter; probasidia globose with a short stalk, 11–14 μ in diameter, becoming somewhat ovate and giving rise to 2, 3 or 4 probasidia, these at first globose, then elongate-ovate, the body merging gradually into the short-subulate sterigma; basidiospores globose, apiculate, (8–)10–12 μ in diameter, germinating by repetiton.

Panamá: Prov. Chiriquí. Valley of upper Rio Chiriquí Viejo, 1600–1800 m. July 11, 1935. Encrusting bark, mosses and lichens on an upper branch of a freshly felled tree at an estimated height of fifty feet above ground. G. W. M. *2750,* type. In Herb. State Univ. Iowa and Missouri Bot. Gard.

The massive, globose basidia of this species (FIGS. 7, 8) mark it off from all hitherto known species of *Tulasnella* except very large examples of *T. violea,* from which it is at once separated by the large, consistently globose spores (FIG. 10). When collected, the bright pinkish-lavendar color made it rather conspicuous. When dry, it forms an inconspicuous whitish mold on the substratum, recovering its waxy consistency but not its color when soaked.

TULASNELLA VIOLEA (Quél.) Bourd. & Galz.

Colombia. Dept. Magdalena. Hacienda Cincinnati, 1250–1500 m. Aug. 12, 1935. G. W. M. *3334.*

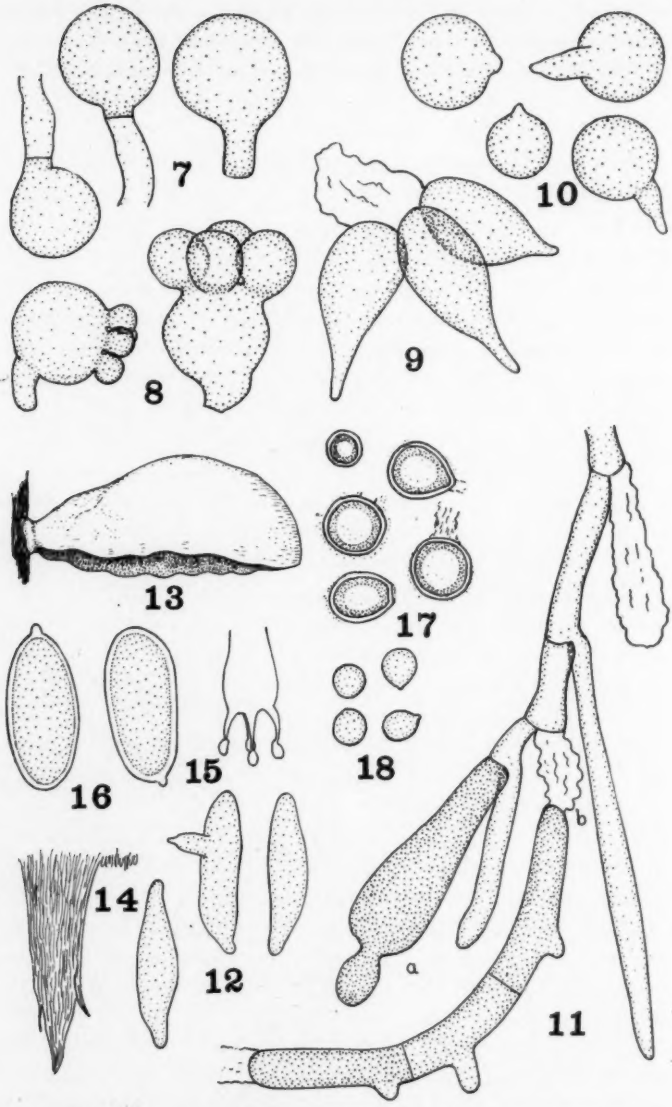
Although the cool, moist climate of the tropical mountains would seem to be ideal for the Tulasnellas, this and the preceding species constitute the only representatives of the genus among my collections. It is not likely they were overlooked, since I was on

the watch for them and both collections were recognized as *Tulasnella* in the field. It is possible that collections made at the beginning of the rainy season would show them to be more abundant.

JOLA JAVENSIS Pat.

The genus *Jola* was established by Möller (Protobasidiomyceten 22. 1895) on the single species *J. Hookeriarum* from Brazil, which he described fully and illustrated. Shortly afterward Patouillard (Bull. Soc. Myc. Fr. **13**: 97. 1897) described two additional species, of which only one, *J. javensis*, from Java, need here concern us. In the same year he published an amplified description of this species, with illustrations (Bull. Jard. Bot. Buitenzorg Supp. **1**: 119. 1897). Gäumann found Patouillard's species to be extremely abundant in the mountains of Java, and not only added to the description, but studied the fungus cytologically (Ann. Myc. **20**: 272–289. 1922).

According to Patouillard, *javensis* differs from *Hookeriarum* in its longer and more clavate probasidia, its curved epibasidia and its smaller spores, the dimensions of which he gives as 15–20 $\times$ 3–4 μ as against Möller's figures of 28–36 $\times$ 6 μ for *Hookeriarum*. To these differences Gäumann adds that the fructifications of *javensis* are consistently globose and gelatinous while those of *Hookeriarum* are less regular in shape and the basidia are not immersed in a gelatinous matrix. With reference to the latter point, Möller does, indeed, say that while the fructifications, when moist, appear to be imbedded in a thin jelly, under the microscope no gelatinous matrix can be seen. His habit sketches (l. c. *pl. 4, f. a*) and the rest of his description suggest strongly that this is a matter of definition, just as in the case of his genus *Stypella*, where, as I have previously pointed out (Univ. Iowa Stud. Nat. Hist. **16**: 143–149. 1934), his statements as to the nature of its fructification have led, as I believe, to misunderstanding. Gäumann gives the spore size as 12–21 $\times$ 3–5 μ, which is in substantial agreement with the dimensions given by Patouillard. His illustrations show probasidia that are consistently elongate-clavate, but the epibasidia are both straight and curved, hence this supposed distinction between the two species cannot be valid. All three authors agree that the hypobasidium is emptied of its contents



FIGS. 7–10. *Tulasnella sphaerospora;* 11, 12, *Jola javensis;* 13–16, *Mycobonia flava;* 17, 18, *Stereum flabellatum.*

when the epibasidium is fully developed and that the latter is cut off by a septum, but all show the empty hypobasidium as plump, with rounded contours, a condition difficult to explain in a thin-walled cell. Furthermore, while Möller gives 90 μ as the maximum length of the epibasidium in *Hookeriarum* as against Patouillard's maximum of 55 μ for *javensis*, the probasidia of *Hookeriarum*, so far as may be judged from the illustrations, are proportionately much smaller. Since the size of the epibasidia is in such cases largely determined by the volume of the probasidia, this again suggests an error in Möller's illustrations.

The specimens here reported were found on patches of a moss in western Panamá on the banks of the Rio Chiriquí Viejo, Prov. Chiriquí, above 1600 m., in July, 1935 (G. W. M. *2272, 2273, 2274, 2339*). Dr. A. J. Sharp, of the University of Tennessee, has kindly identified the host as a species of *Raphidorrhynchium*. They differ in certain minor respects from the descriptions of both *J. Hookeriarum* and *J. javensis*. I find ovate, clavate and cylindrical probasidia in the same fructification, but the clavate type is decidedly the most abundant. They are extremely variable in size, ranging from 14–35 μ in length and 5.5–7.5 μ in diameter. The epibasidium develops as a cylindrical filament, separated from the hypobasidium by a marked constriction (FIG. 11*a*) much as shown in Möller's and Patouillard's figures but less apparent in those of Gäumann. It may be straight or curved, and may finally attain 60 μ in length, occasionally slightly more, and 5–6 μ in diameter. In the formation of the epibasidium, the hypobasidium is entirely emptied of its contents and cut off by a septum, after which it promptly collapses (FIG. 11*b*), not remaining plump as shown in the illustrations of all three of the authors cited. The spores are mostly 20–22 μ in length, rarely somewhat shorter or longer, and 4.5–5 μ in width (FIG. 12). They germinate by repetition, as shown by Möller and Gäumann, except that in all the instances observed the secondary epibasidium was developed laterally.

The fructifications themselves are mainly globose (FIG. 5), but not uncommonly irregular, and while they were mostly on the capsules a number occurred on the stalks of the sporophores. They are certainly gelatinous but when mounted for microscopic

observation, no gelatinous matrix such as is clearly visible in *Auricularia, Tremella* and *Exidia* can be seen.

Except for spore size, I cannot regard the published distinctions between *Jola Hookeriarum* and *J. javensis* as very significant, and even spore size tends to be much more variable in the Protobasidiomycetes than in most other fungi. While my specimens are somewhat intermediate even in this respect, I assign them to Patouillard's species for the time being on the basis of the predominantly clavate probasidia and the small spores, but with a strong suspicion that that species will eventually be reduced to a synonym of *Hookeriarum*.

STEREUM FLABELLATUM Pat.

Originally described from Guadeloupe, this species was reported in Standley's first list of fungi from Barro Colorado Island (Smithsonian Misc. Coll. **78** (8): 7. 1927). Patouillard's original description (Bull. Soc. Myc. Fr. **16**: 179. 1900) refers to it as whitish when living, livid and pellucid when dry. Burt's description (Ann. Missouri Bot. Gard. **7**: 111. 1920) is mainly a translation of Patouillard's. Neither mentions the spores.

The form which I refer to this species is abundant on Barro Colorado Island, where large logs are frequently covered with the delicate pilei. When young, they are pure white, becoming somewhat dingy when older, and drying livid and translucent, with dark-brown or bay stems. A few basidiospores were found, none attached to sterigmata, but evidently belonging to the species. These are smooth, hyaline, globose or subglobose, and 4–5 μ in diameter (FIG. 18). In numerous sections, basidia were entirely lacking, but the pileus, 300–450 μ in total thickness, had the lower fourth more or less transformed into a layer of spherical or broadly ovate chlamydospores (FIG. 17), variable in size but mostly 4–8 μ in diameter or in the longer dimension. These are often attached to shrivelled hyphae and surrounded by an indistinct gelatinous sheath. The wall is thick, 0.7–1 μ, and most of the interior is occupied by a large vacuole. It is possible, of course, that these represent the spores of a parasitic fungus, but their appearance and manner of development is such as to render it improbable.

MYCOBONIA FLAVA (Berk.) Pat.

Although this species occurs from the southern United States to the Argentine and has been collected a number of times it is still inadequately known. Originally described from Jamaica as a *Peziza* by Swartz in 1788, it was transferred by Berkeley to *Hydnum* (Ann. Mag. Nat. Hist. I. **10**: 380. 1842). Some years later Berkeley described *H. brunneoleucum* Berk. & Curt. (Trans. Linn. Soc. **22**: 129. 1859), from Venezuela, as a closely allied species, differing in the paler color of the hymenium and the divided "bristles."

Patouillard (Bull. Soc. Myc. Fr. **8**: 49. 1892) in establishing the genus *Bonia* on a resupinate species, *B. papyrina*, from Tonkin, remarked incidentally that *Hydnum flavum* should be referred to this genus. According to Patouillard himself, *Bonia* Pat. proves to be a homonym of *Bonia* Balansa, and judging from the description, his *B. papyrina* may be either a *Veluticeps* or a *Heterochaete*. At any rate, two years later he established the genus *Mycobonia* (Bull. Soc. Myc. Fr. **10**: 77. 1894), basing it on *H. flavum*. Still later (Bull. Soc. Myc. Fr. **16**: 180–181. 1900), in reporting both species from Gaudeloupe, he published the combination *M. brunneoleuca*, applying this name to the stipitate forms and retaining the sessile forms in *M. flava*. He notes that *brunneoleuca* may attain a diameter of 15 cm. Banker (Mem. Torrey Club **12**: 179. 1906), unaware of Patouillard's treatment and of the sterile nature of the teeth, included these forms in the Hydnaceae, establishing for them the genus *Grandinioides* and regarding both as phases of a single species. He properly emphasizes the subgelatinous nature of the pileus, but his suggestion that *brunneoleuca* "appears to be only a poorly developed form of *G. flavum*," while warranted by Berkeley's descriptions, is at variance with Patouillard's comment. Lloyd (Myc. Writ. 4. Letter **56**: 11. 1915) also regarded both forms as included in a single species. Hennings (In E. & P. Nat. Pfl. I. **1****: 123. 1897) retains the species in *Bonia* and this disposition is maintained by Killermann in the second edition. Burt (Ann. Missouri Bot. Gard. **6**: 262. 1919) recognizes both species, describing *flavum* as sessile, with a buff hymenium, and *brunneoleucum* as short-stipitate, with a pallid

hymenium, thus utilizing both Berkeley's and Patouillard's distinguishing characters.

The specimens was common in July, 1935, in western Panamá in the valley of the upper Rio Chiriquí Viejo above 1600 m., and is represented by seven collections. The specimens vary from sessile with a constricted base, to short-stipitate, the stipe commonly dark, but sometimes concolorous with the bright tan of the upper side of the pileus. The hymenium is a duller and paler tan, and might well be described as whitish in some of the older sporophores. When fresh it was purplish tan, and under a lens it could be seen that the purplish color was due to the numerous purple pegs protruding from the pale tan hymenial surface. The purplish tint largely disappears in dried specimens. The largest basidiocarp collected measured 7 cm. in the stem axis and 9 cm. across. The shape in every case was much more concave and shell-like than is suggested by Hennings' figure (Engler and Prantl I. 1**: 122 f. 68G), which looks as though it had been drawn from a flattened specimen. Berkeley's later characterization of *H. brunneoleucum* (Jour. Linn. Soc. Bot. **10**: 324. 1868), "pileo tenui galeaeformis" is very vivid and entirely applicable to these specimens as they occurred in nature. The habit sketch (FIG. 13) redrawn from a field sketch, attempts to bring this out.

In young sporophores the pegs are regularly conical; later they become fimbriate (FIG. 14) and, when dry, justify Berkeley's reference to "granuliform processes." The sporophores, when soaked, are very tough-gelatinous, and difficult to section. The hymenium is extremely dense and contains, in addition to the somewhat sparsely spaced basidia, densely refractive clavate and fusiform bodies, some of which are probably young basidia and others paraphyses, and subgelatinous hairs similar to those which make up the pegs. The spores are smooth and noticeably thick-walled (FIG. 16), and, according to my measurements, when fully mature, 21–22 × 8.5–10 μ, considerably above the dimensions Burt gives.

On the basis of the fairly ample material at my disposal, I am convinced that Banker and Lloyd were justified in combining the two supposed species. Slight variations in the color of the hymenium in dried, as in fresh specimens, may be explained as due

largely to the stage of development of the sporophore at the time of collection. The presence or absence of a stipe seems to be determined by the accident of position, and especially by the size of the substratum, forms growing on small twigs, as was the specimen first studied by Berkeley, showing a greater tendency to be sessile than applanate sporophores growing laterally on large trunks.

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EXPLANATION OF FIGURES

FIGS. 1–4. *Sclerocystis coccogena.* 1, outer surface of stroma, × 3⅓; 2, inner surface freed from substratum, showing sporocarps, × 3⅓; 3, section of portion of stroma, showing sporocarps and pseudotissue of large hyphae which comprise the stromatic wall, × 20; 4, section of single sporocarp, showing inner portion of peridium and chlamydospore (at left), × 107.

FIG. 5. *Jola javensis,* four fructifications on moss capsules, × 3⅓.

FIG. 6. *Mycobonia flava,* upper surface at left, lower at right, × ⅔.

FIGS. 7–10. *Tulasnella sphaerospora.* 7, three probasidia; 8, epibasidia developing; 9, basidium with three epibasidia, hypobasidium empty and collapsed; 10, four basidiospores, two germinating by repetition. All × 1200.

FIGS. 11–12. *Jola javensis.* 11, tip of basidium-bearing branch, showing clavate probasidium with epibasidium starting to develop (*a*), mature epibasidium with collapsed hypobasidium (*b*), the apical cell empty and collapsed, the three lower cells beginning to develop lateral branches, above, a collapsed hypobasidium from which the epibasidium has fallen away; 12, three basidiospores, the middle one germinating by repetition. Both × 1200.

FIGS. 13–16. *Mycobonia flava.* 13, habit sketch, redrawn from field sketch of fresh specimen, × 1; 14, hyphal peg, × 250; 15, tip of basidium, × 555; 16, two basidiospores, × 1200.

FIGS. 17–18. *Stereum flabellatum.* 17, five chlamydospores; 18, four basidiospores. Both × 1200.

FIGS. 7–12 and 14–18 drawn with aid of camera lucida and reproduced at approximately the magnifications indicated.

COPRINUS URTICAECOLA ON STEMS OF MARQUIS WHEAT [1]

W. F. HANNA

(WITH 2 FIGURES)

In the spring of 1934 vernalized seed of Marquis wheat that had been inoculated with loose smut, *Ustilago Tritici*, was sown in rows in the field at Winnipeg for the purpose of determining the effect of the vernalization treatment on loose smut development. In July, when the rows were being examined for smut infection, it was observed that fruit-bodies of a small agaric were developing on the stems of two of the plants, close to the ground level. At the time this observation was made the plants were still green, and those to which the fungi were attached appeared to be as healthy as any of the others.

When the two plants referred to were examined later in the laboratory it was found that the fruit-bodies were attached to the leaf sheaths at a point about half an inch above the crown. The leaf sheaths themselves were dead, although the stems which they enclosed were still green. From one plant two, and from the other eight fruit-bodies developed. Their appearance is shown in figure 2, *A–D*.

The fruit-bodies produced on Marquis wheat, as well as those appearing subsequently in pure culture, answered to the description of *Coprinus urticaecola* [3] (Berk. & Br.) Buller. This fungus, originally placed in the genus *Psathyra* in 1861, was collected in 1912 on sticks, dead leaves, and haulms of *Holcus lanatus* at Kew, England, by Prof. Buller (1 and 2), who transferred it to the genus *Coprinus*.

[1] Contribution No. 561, Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Canada (continuing the Series of the former Division of Botany).

[2] Senior Plant Pathologist, Dominion Rust Research Laboratory, Winnipeg, Manitoba.

[3] The preferred spelling according to the International Rules of Botanical Nomenclature is *Coprinus urticicola*.

In July, 1937, *C: urticaecola* was found again at Winnipeg, growing profusely on decaying nettle stems. Buller (**1**, **2**) states that the fruit-bodies are "chalky white," but it is inferred from his account that the specimens on which his description was based developed on sticks that had been placed in a damp chamber. Under such conditions it was found that fruit-bodies developing at Winnipeg were usually white, whereas those growing in a less humid atmosphere were frequently ornamented with brown scales (FIG. 2, *A*, *E*).

In 1881 Karsten (**3**) described *C. phaeosporus*, found growing at the roots of decaying grass. This species was later described by Lange (**5**) from specimens collected at Hjallese, Denmark, on a "loamy rubbish-heap among germinating grass seed." Judging from the description and illustrations given in Lange's published account, and in his correspondence with the writer, it is considered highly probable that *C. phaeosporus* and *C. urticaecola* are identical.

C. Brassicae Peck, described and illustrated in 1889 (**8**), is probably also identical with *C. urticaecola*. This species was found by Peck on decaying stems of cabbage and was considered by him to be related to *C. phaeosporus* Karst., *C. Friesii* Quél., and *C. tigrinellus* Boudier. It was later collected on corn stalks by Murrill (**7**) who gave a complete description of it with illustrations. Kauffman (**4**) also described *C. Brassicae* from specimens gathered on "corn stalks, weed stalks, and dead grass."

Species of the genus *Coprinus* are usually saprophytic and, so far as the writer is aware, there is no published account of their occurence in association with living wheat plants. Other species of agarics have frequently been found on the stems of cereals but the exact nature of their relationship with their hosts, whether parasitic, saprophytic, or symbiotic, has not been ascertained.

Both Tehon (**10**) and Young (**11**) reported a species of *Marasmius* on cereals in the United States, and some of the plants from which the fruit-bodies developed showed symptoms of injury. A species closely resembling *M. insititius*[4] was found by Mains (**6**) on dying stems and leaves of *Festuca capillata*, but whether or not the mycelium of the agaric was responsible for the condition of the plants was not determined. More recently Sprague (**9**) pub-

[4] *Vide* Mains (**6**) *Marasmius insititious* Fries.

lished a brief account of the occurrence of species of *Pholiota* and *Naucoria* on the crowns of oats, barley, and wheat in Oregon. He found that Basidiomycetous mycelium was sometimes present in the cortical cells of the roots, but its presence there did not seem to be associated with any injurious effects. On the contrary, when

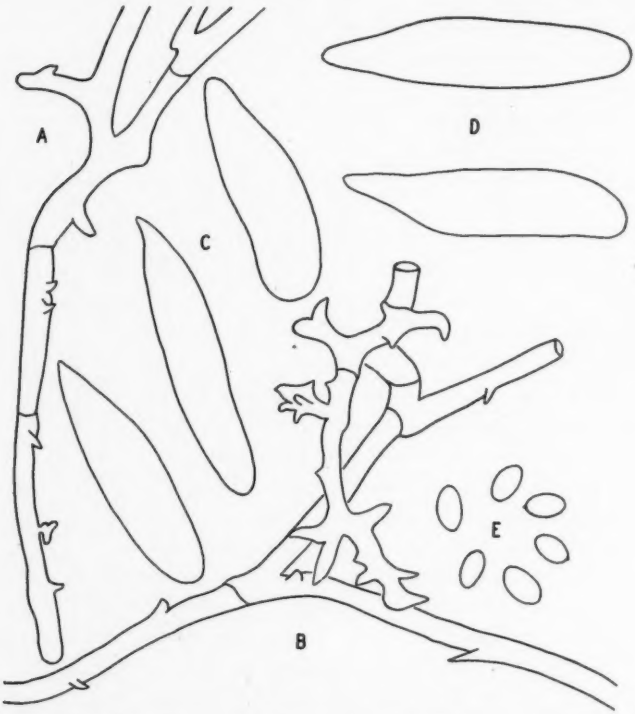

FIG. 1. *Coprinus urticaecola:* A, B, hyphae from surface of pileus, × 700; C, three cystidia from the edges of the gills, × 700; D, two cystidia from between the gills, × 700; E, spores, × 800.

pure cultures made from certain of the agarics referred to were introduced into soil in which cereals were growing the inoculated plants developed more vigorously than the uninoculated ones.

Plants of Marquis wheat growing in pots in the greenhouse were inoculated with a diploid culture of *Coprinus urticaecola* by placing about the stems at soil level pieces of agar from fresh cultures, and

covering them with a little soil. When inoculated, some of the plants were still in the seedling stage and others were just beginning to produce heads. Although the plants were kept under observation for nearly four months no fruit-bodies appeared either on the stems or on the soil.

Fruit-bodies of *C. urticaecola* were produced by diploid cultures of the mycelium growing on the following substrata: (1) Sterilized soil and horse-dung. (2) Sterilized soil and old wheat stems. (3) Sterilized horse-dung. Fruit-bodies arising from cultures growing on sterilized horse-dung alone usually failed to develop completely and discharge spores. Good fruit-bodies were secured, however, by growing the diploid mycelium on sterilized horse-dung until the latter was converted into pure-culture spawn, and transferring the spawn to a pot nearly filled with unsterilized soil. A thin layer of soil was then dusted over the spawn and it was moistened and covered with a glass dish. Normal fruit-bodies usually appeared on the surface of the soil in about three weeks (FIG. 2, *E*).

Freshly collected spores of *C. urticaecola* when placed on potato-dextrose agar at laboratory temperature began to germinate in about four hours. The mycelium also grew well on this medium. Spores collected on glass slides and stored for a year at 10° C. still showed about 50 per cent germination, but spores kept for two years under these conditions were no longer viable.

C. urticaecola is heterothallic, and when two monosporous mycelia of opposite sex are allowed to intermingle they give rise to a diploid mycelium bearing clamp connections. Sometimes cultures of opposite sex display an aversion to one another and the diploid mycelium appears as a fan-shaped sector growing out from the margin of the colonies near where they meet. The monosporous mycelia derived from a single fruit-body, when paired together in all possible ways, fall into two sexual groups. This is illustrated in tables 1 and 2. The (+) sign indicates that the mating in question has resulted in the production of diploid mycelium bearing clamp connections; the (—) sign indicates that the two mycelia have failed to react with each other.

Four dark-brown sclerotia developed in a diploid culture of *C. urticaecola* that had been kept for six months at 10° C. on a slant

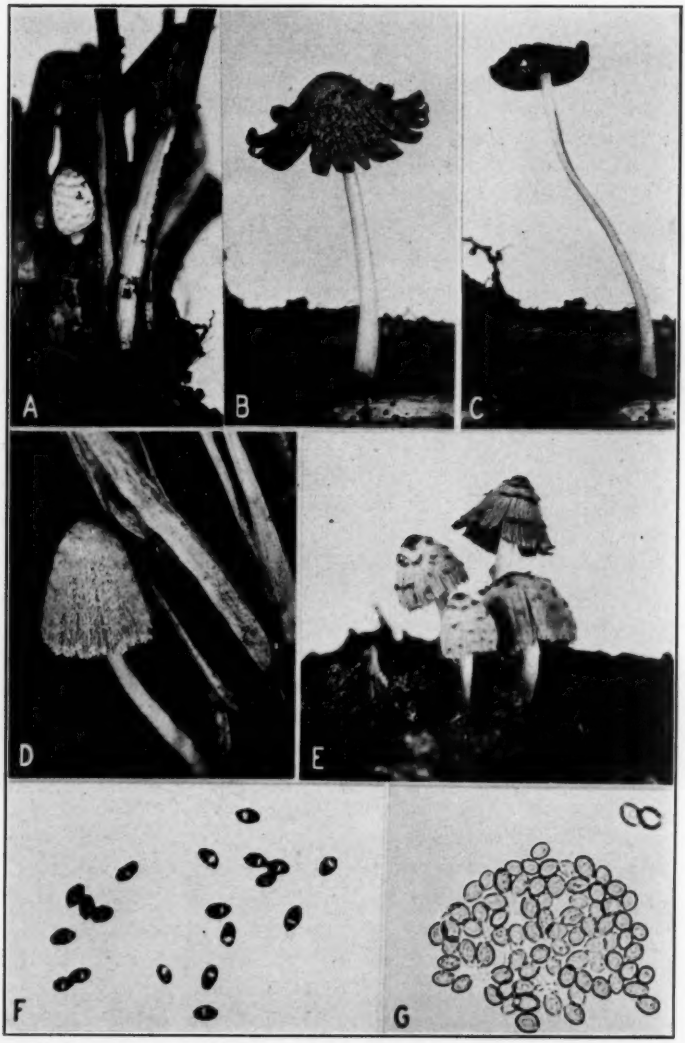

FIG. 2. *Coprinus urticaecola:* A–D, wild fruit-bodies growing on stems of Marquis wheat, × 1⅓; E, fruit-bodies produced in pure culture by two monosporous mycelia of opposite sex growing on sterilized horse-dung, × 1⅓; F, photomicrograph of dry spores collected on a glass slide, × 435; G, photomicrograph of spores mounted in water, × 435.

TABLE I

ALL POSSIBLE PAIRINGS OF SEVEN MONOSPOROUS MYCELIA OF *Coprinus urticaecola* DERIVED FROM SPORES OF A SINGLE FRUIT-BODY

	1	6	7	2	3	4	5
1	—	—	—	+	+	+	+
6	—	—	—	+	+	+	+
7	—	—	—	+	+	+	+
2	+	+	+	—	—	—	—
3	+	+	+	—	—	—	—
4	+	+	+	—	—	—	—
5	+	+	+	—	—	—	—

TABLE 2

ALL POSSIBLE PAIRINGS OF TEN MONOSPOROUS MYCELIA OF *Coprinus urticaecola* DERIVED FROM SPORES OF A SINGLE FRUIT-BODY

	8	10	11	13	15	9	14	16	17	18
8	—	—	—	—	—	+	+	+	+	+
10	—	—	—	—	—	+	+	+	+	+
11	—	—	—	—	—	+	+	+	+	+
13	—	—	—	—	—	+	+	+	+	+
15	—	—	—	—	—	+	+	+	+	+
9	+	+	+	+	+	—	—	—	—	—
14	+	+	+	+	+	—	—	—	—	—
16	+	+	+	+	+	—	—	—	—	—
17	+	+	+	+	+	—	—	—	—	—
18	+	+	+	+	+	—	—	—	—	—

of potato-dextrose agar. The culture in question had been made by combining monosporous mycelia 3 and 6 (Table 1). Sections were cut through the largest of the four sclerotia, which was about 3 mm. in diameter, and they were examined under the microscope. The interior of the sclerotium was white, and composed of compact hyphae made up of short, thick, irregularly shaped cells.

After an examination of both wild and cultivated fruit-bodies of *C. urticaecola,* and a study of pure cultures, the following description of the species was prepared:

Pileus before expansion campanulate, sometimes completely white, but usually ornamented towards the apex with brown scales; on expansion becoming conical, from 10 to 30 mm. in diameter, finally umbonate, with margin split and recurved; surface of the pileus covered with a detachable felty layer consisting of pale-brown much-branched hyphae (FIG. 1, *A, B*). *Gills* thin, crowded, chocolate-coloured; cystidia abundant on the edges of the gills and bridging the interlamellar spaces (FIG. 1, *C, D*), up to 115 × 12 μ; basidia 4-spored. *Stem* from 20 to 60 mm. in length and from 1 to 2 mm. in diameter, white, hollow, smooth above, slightly squamulose towards the base, attenuated upwards. *Spores* chocolate-coloured in the mass, elliptical, mostly 7.5 × 5 μ.

Fruit-bodies gregarious; on decaying nettle stems, and on the basal leaf sheaths of wheat plants. The species is heterothallic and bisexual. The diploid hyphae bear clamp connections. Small sclerotia appeared in a diploid culture growing on potato-dextrose agar.

SUMMARY

1. *Coprinus urticaecola* (Berk. & Br.) Buller was found at Winnipeg in 1934 on Marquis wheat. The fruit-bodies were attached near the ground level to leaf sheaths of green plants. In 1937 the species was collected again on decaying nettle stems. It is considered to be identical with *C. Brassicae* Peck, and *C. phaeosporus* Karst. *sensu* Lange.

2. Spore germination and growth of the mycelium occurred readily on potato-dextrose agar. The species fruited on a number of sterile media, but fruit-bodies failed to appear when wheat plants growing in the greenhouse were inoculated with pure cultures of the mycelium.

3. *C. urticaecola* is heterothallic and bisexual. The diploid mycelium bears clamp connections. Small sclerotia were formed on one of the diploid cultures growing on potato-dextrose agar. The species is described and illustrated.

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LEAFSPOT OF ASH AND PHYLLOSTICTA VIRIDIS

FREDERICK A. WOLF

(WITH 14 FIGURES)

A leafspot disease whose causal fungus is commonly identified as *Phyllosticta viridis* Ellis & Kellerm. occurs on ashes within the area comprising the Duke Forest. The disease has been noted here on white ash, *Fraxinus americana* L., red ash, *F. pennsylvanica* Marsh., and green ash, *F. pennsylvanica* Marsh. var. *lanceolata* (Borkh.) Sarg. (*F. viridis* L.). Seaver (**7**), from collections in the herbarium of The New York Botanical Garden, recorded *P. viridis* from Connecticut, Illinois, Kansas, Louisiana, Nebraska, New York, and South Dakota, and therefore it is presumed to be widespread east of the Rocky Mountains. Since a detailed study of the life history and development of the pathogen has not been made previously the investigations herein recounted were undertaken.

Appearance of affected leaves. Trees of all ages were subjected to this *Phyllosticta* leafspot. Examination of the leaves toward the end of the summer reveals that the lower leaf surface is occupied by widely dispersed, black structures, the fructifications of the fungus. These structures may occur in patches or be more or less uniformly distributed over the entire lower leaf surface. When leaves are viewed from the upper side, during August, there may be no apparent discoloration of tissues or, at most, the leaves may be only slightly less green than normal. As the season advances however, indefinite-margined, pale green spots appear that gradually increase in size, and by mid-September large necrotic areas 0.5–1.5 cm. across have developed (FIG. 1). Meanwhile the black structures will have increased in number to such an extent as densely to occupy the necrotic spots, and defoliation will have begun. Large trees, all of whose foliage was affected, have been observed to be completely defoliated 4 to 6 weeks before killing frosts occurred.

Identity of the pathogen. Examination of the black fungous structures, after maceration in water on a glass slide, shows that they may be identified as the fructifications of *Phyllosticta viridis.* Ellis and Kellerman (2), in 1889, described this fungus from specimens collected in Rocks County, Kansas. My identification of the organism has been confirmed by comparison with type specimens [1] among the collections in the herbarium of the Office

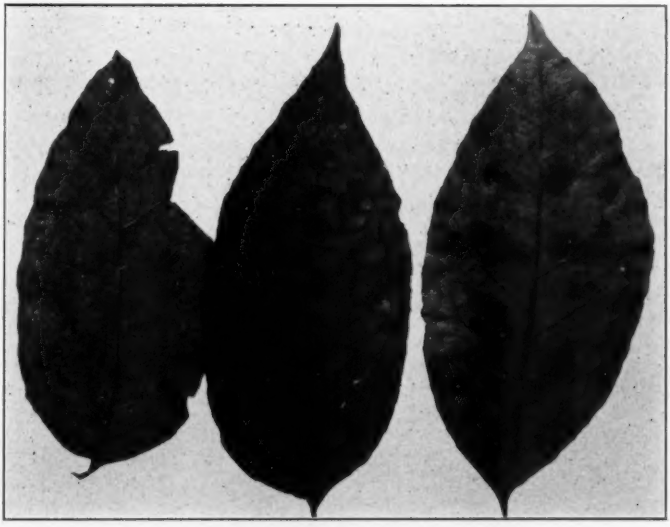

FIG. 1. Ash leaflets affected with the so-called *Phyllosticta* leaf spot; the outer ones, viewed from the lower surface, the middle ones from above. Note the widely distributed black stromata on the two outer leaflets.

of Mycology and Disease Survey, U. S. Department of Agriculture.

Since certain species of *Phyllosticta* are known to possess an ascogenous stage, decaying affected ash leaves were examined from time to time throughout the autumn and winter in search of such a stage. By the middle of March leaves bearing mature perithecia were gathered. The location and distribution of the perithecia (FIG. 2) was noted to be like that of the *Phyllosticta* stage,

[1] Comparison of specimens was made by Dr. W. W. Diehl for which courtesy acknowledgment is herewith made.

and furthermore the structure of these perithecia showed that they belonged to the genus *Mycosphaerella* (*Sphaerella*). Comparison of these collections with other species of *Mycosphaerella* [2] on ash showed them to be identical specifically with *Mycosphaerella fraxinicola* (Schw.) House (**4**). This stage was first described as *Sphaeria fraxinicola* by de Schweinitz (**6**) in 1831, from collections made near Bethlehem, Pa. His description was emended by Cooke (**1**), in 1883, who examined specimens on white ash collected near Darien, Ga., and gave the fungus the name *Sphaerella fraxinicola* (Schw.) (**5**).

Structure of the fungus. Knowledge of the microscopic anatomy of the organism was gained by use of paraffine sections of leaves bearing fructifications. Formalin acetic alcohol was used as a fixing solution, and the sections, cut 5 to 8 μ thick, were stained with Haidenhain's iron alum hematoxylin. Sections of infected leaves, collected near the middle of August, showed that the black fungous structures that had been presumed to be pycnidia are in reality stromata, each containing one to three locules. Moreover, these locules are of two types, spermogonial and carpogonial, both types sometimes occurring within the same stroma.

Spermogonia. The peripheral portions of the stromata are composed of thick-walled cells, devoid of stainable content. The outer wall (FIG. 4) is much thickened. In young spermogonia the locules are loosely filled with thin-walled, deeply staining spermatiferous cells, arranged in chains.

Spermatial formation is initiated near the center of the locule and proceeds centrifugally. Each cell appears to function as a spermatium mother cell and produces four spermatia in the same manner as does *Sphaerella bolleana* Higgins (**3**). The spermatia are liberated *seriatim* from the apex of a sterigma formed on each cell (FIG. 6). Then the mother cell walls disintegrate, their residue contributing to a mucilaginous matrix that swells in the presence of moisture and causes the spermatia to ooze to the leaf surface. The ostiolar outlet through which the spermatia escape, is developed concurrently with the formation of the first spermatia.

[2] Dr. D. H. Linder, Farlow Herbarium, Harvard University sent me specimens of this fungus collected in Ohio, in 1882, by W. A. Kellerman and determined by J. B. Ellis. This kindness is gratefully acknowledged.

Mature spermogonia (FIG. 4) may appear to be multilocular, as indicated by the several streams of spermatial ooze converging at the ostiolum. This appearance is produced because of the fact that the formation of spermatia does not involve all cells centrifugally at the same rate, chains of spermatiferous cells remaining as partitions.

Perithecia. Perithecial development is initiated coincidentally with that of the spermogonia. By the time that spermatia are beginning to be discharged, conspicuous deeply staining carpogonia

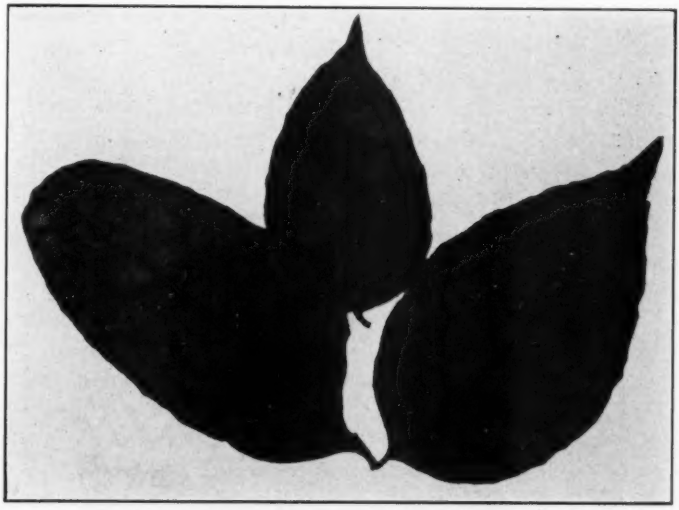

FIG. 2. Perithecial stage of *Mycosphaerella fraxinicola* on ash leaflets.

have become differentiated within the perithecial initials (FIG. 3). From one to four septate carpogonia occur within each locule. The coiled basal portion or ascogonium is enlarged (FIG. 5), and the filamentous portion or trichogyne courses tortuously to the exterior. Each of the several cells composing a carpogonium is at one time uninucleate but it has not been possible to trace the nuclear transformations and structural modifications that eventually lead to the formation of asci. It has been impossible to ascertain moreover, whether all of the carpogonia function or

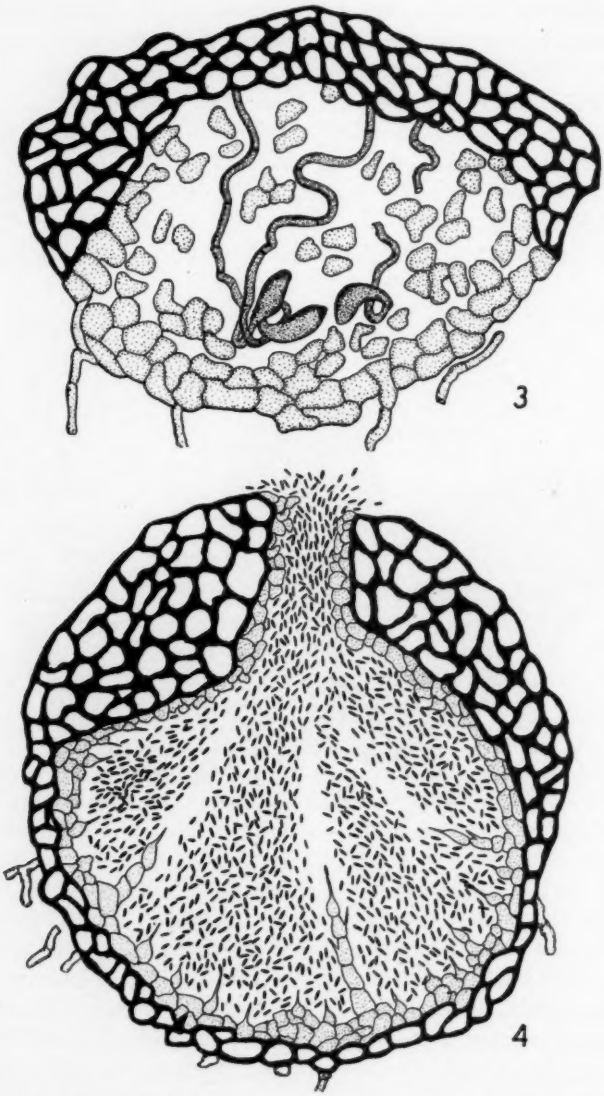

FIG. 3. Young perithecial stroma bearing three coiled carpogonia; 4, mature spermogonium of *M. fraxinicola.*

whether all except one disintegrate. Furthermore it is not known whether the spermatia function to fertilize the ascogonia before the development of ascogenous hypae and asci but, in all probability, such is the case.

In early spring the perithecial locules are filled with cells with dense protoplasmic content (FIG. 10) that appear to constitute the reserve food for the developing asci. Mature perithecia are spherical with a short ostiolar papilla, and vary in diameter from 75 to 100 μ. When perithecia are crushed in water on a microscopic slide a fascicle of asci is liberated. Mature asci measure 40–50 $\times$ 10–12 μ and contain eight ascospores, usually biseriately arranged (Fig. 8). The ascospores are hyaline, 1-septate, the basal cell being the smaller, and they measure 8–10 $\times$ 4–4.5 μ.

Life history. An attempt was made to learn something of the life cycle of *M. fraxinicola* by use of cultures. Isolates from ascospores were secured by permitting them to be forcibly discharged onto inverted agar plates. Here they germinated readily (FIG. 12, 13) and small grayish-black to brownish-black colonies were developed. Tissue plantings from infected green leaves yielded similar colonies. Conidia were not produced in these cultures. All attempts to germinate spermatia failed.

Samples of decaying leaves that had remained out of doors continuously were examined at intervals from March 15 to July 1 to determine the duration of the period of ascospore discharge. Nearly all of the perithecia were empty by the latter date, and it may be concluded that *M. fraxinicola* is capable of discharging its ascospores over an extended period. On expulsion the ascospores are probably carried to the foliage by currents of air, and infection follows. The mycelium remains intercellular (FIG. 14), develops slowly, and pathogenesis is first evident about mid-August when the spermogonial and carpogonial stromata rupture the epidermis of the lower leaf surface. A conidial stage has not been found although such a stage is known to be commonly associated with other species of *Mycosphaerella.*

Taxonomic resume. Since this study genetically connects, for the first time, the so-called *Phyllosticta viridis* with *Mycosphaerella fraxinicola* it is desirable to emend the mycological description of the organism as follows:

MYCOSPHAERELLA FRAXINICOLA (Schw.) House. Ann. Rep. N. Y. State Museum 73: 27. 1921.

Sphaeria fraxinicola Schw. Trans. Am. Phil. Soc. **4**: 224, 1831, No. 1787.

Sphaerella fraxinicola (Schw.) Cooke, Jour. Bot. **21**: 107. 1883.

Phyllosticta viridis Ellis & Kellerm. Jour. Myc. **5**: 142. 1889.

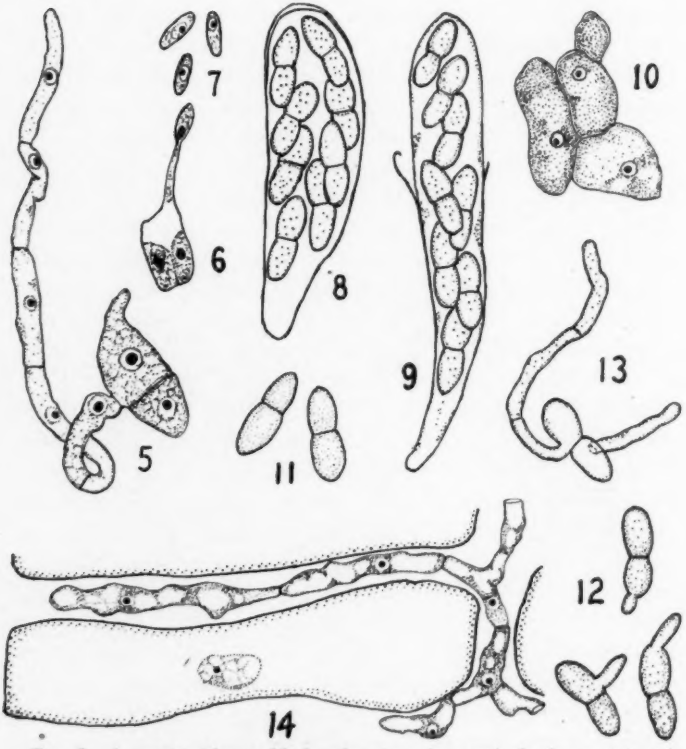

FIG. 5. A carpogonium with basal ascogonium and slender septate trichogyne; 6, spermatium mother cell, with sterigma like process on which a spermatium is being formed; 7, spermatia; 8, mature ascus of *M. fraxinicola* as seen when perithecia are macerated; 9, elongated ascus ready for discharge of ascospores; 10, uninucleate cells, densely filled with protoplasm, from the interior of a carpogonial stroma; 11, ascospores of *M. fraxinicola;* 12, 13, germinating ascospores; 14, palisade parenchyma cells and intercellular mycelium of *M. fraxinicola.*

Peritheciis hypophyllis, subinnatis, nigris, sparsis vel tantum conjunctis maculam atram efficientibus, minorem maculis quasi confluentibus inter se, sphaericis, 70–100 μ; ascis clavatis, abbreviatis, aparaphysatis, octosporis, 40–50 × 10–12 μ; sporidiis biseriatis interdum inordinatis, subellipticis, uniseptatis, loculo inferiore teniore, hyalinis, 8–10 × 4–4.5 μ.

Hab. in pagina aversa foliorum Fraxini spp., frequens.

Status spermogonicus: Statum spermogonicum Phyllosticta viridis sistit. Maculis magnis, subindefinitis, margine subpallidioribus, 0.5–1.5 cm. lat.; spermogoniis in stromatibus efformatis, suberumpentibus, punctiformibus, nigris, 65–80 μ diam.; spermatiis intus loculo spermogonico oriundis, copiosis, bacilliiformibus, hyalinis, 2–3 × 1 μ.

Hab. in foliis vivis vel in laesionibus emortuis. Fraxini spp., in aestivo atque autumno.

For the convenience of mycologists, specimens have been deposited in the Farlow Herbarium, Harvard University, and in the herbarium of Mycology and Disease Survey, U. S. Department of Agriculture.

SUMMARY

The foliage of several species of *Fraxinus* may be affected by a fungus commonly identified as *Phyllosticta viridis* Ellis & Kellerm. This organism is widely distributed within the United States in the area east of the Rocky Mountains.

In late summer lesions form on the leaves and severe defoliation may follow. The presence of black stromata, protruding from the lower leaf surface, aids in diagnosis. The stromata at this stage have been found to contain both spermogonial and carpogonial locules, and the spermogonial stage is identical with *Phyllosticta viridis*. The carpogonial locules, each with one or more carpogonia, become transformed, by early spring, into mature perithecia. The perithecial stage has been identified as *Mycosphaerella fraxinicola* (Schw.) House.

The period of ascospore discharge extends into early summer. Infection is first apparent by the presence of stromata. The evidence in hand indicates that *M. fraxinicola* does not develop a conidial stage.

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DURHAM, N. C.

EXPLANATION OF FIGURES

FIG. 1, Ash leaflets affected with the so-called *Phyllosticta* leaf spot; the outer ones, viewed from the lower surface, the middle one from above. Note the widely distributed black stromata on the two outer leaflets; 2, Perithecial stage of *Mycosphaerella fraxinicola* on ash leaflets; 3, Young perithecial stroma bearing three coiled carpogonia; 4, Mature spermogonium of *M. fraxinicola*; 5, A carpogonium with basal ascogonium and slender septate trichogyne; 6, Spermatium mother cell, with sterigma like process on which a spermatium is being formed; 7, Spermatia; 8, Mature ascus of *M. fraxinicola* as seen when perithecia are macerated; 9, Elongated ascus ready for discharge of ascospores; 10, Uninucleate cells, densely filled with protoplasm, from the interior of a carpogonial stroma; 11, Ascospores of *M. fraxinicola*; 12, 13, Germinating ascospores; 14, Palisade parenchyma cells and intercellular mycelium of *M. fraxinicola*.

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STUDIES IN THE GENUS MYCENA. V[1]

ALEXANDER H. SMITH

(WITH 4 FIGURES)

During the season of 1937, with the aid of a grant from the Horace H. Rackham School of Graduate Studies of the University of Michigan, the writer was enabled to continue his investigations of the *Mycena* flora of the west coast. The locations selected for study were Blue River, Ore. on the western slope of the Cascade Mountains just below McKenzie Pass, and Crescent City, Calif., a small town on the coast a short distance south of the Oregon line. From the middle of October until the first of November, the *Mycena* flora on the moss and needle carpets under the various species of conifers which inhabit the western slope of the Cascades was the most luxuriant I have yet encountered anywhere. *Mycena tenax* Smith occurred everywhere in patches of hundreds of individuals, and *Mycena quiniaultensis* Smith was more abundant than I have ever seen it before. *Mycena flavoalba* (Fries) Quél., a species I had not encountered previously, was very abundant under Douglas fir at elevations of between two thousand five hundred and three thousand five hundred feet. *Mycena rosella* (Fries) Quél. and *Mycena strobilinoidea* Peck, covered the needle carpet under pine. In addition to many of the known species, an exceptionally large number of species previously undescribed were also collected. Some of these were relatively rare and some were as abundant as *Mycena rosella* or *Mycena tenax*. The most interesting feature of the agaric flora at Blue River was the large proportion of species of *Mycena*. They made up about sixty per cent of the agaric flora. At Crescent City the ratio was closer to that usually found (five to twenty per cent). Here again, however, many very unusual species were found in greater abundance than those usually considered common. *Mycena haematopoda* (Fries) Quél. and *Mycena occidentalis* Murr., for instance, were rare.

[1] Papers from the Herbarium of the University of Michigan.

In this paper twelve species of *Mycena* are described as new. Ten of these were collected along the west coast, two being abundant in 1935 and rare in 1937. The remaining two are from eastern United States. One of these was obtained while the writer was engaged in a survey of the fungous flora of Oakland County, Mich., in cooperation with the Cranbrook Institute of Science, Bloomfield Hills, Mich. The other was collected in Michigan and New York during the season of 1934.

The collection numbers and photographs are the writer's. All color names are taken from *Color Standards and Color Nomenclature*, R. Ridgway, Washington, D. C., 1912. The collections are deposited in the Herbarium of the University of Michigan.

Mycena corticalis sp. nov. (FIG. 1, *B*).—Pileus 6–12 (155) mm. latus, cylindricus vel convexus, demum late convexus, griseus, glabrus; cheilocystidia 20–25 × 6–8 μ, clavata, echinulata; sporae 9–11 × 7–9 μ.—Specimen typicum in Herb. Univ. of Mich. conservatum: Legit prope Blue River, Ore., Oct. 22, 1937, A. H. Smith No. *8046*.

Pileus 6–12 (15) mm. broad, cylindric, conic or convex, remaining unexpanded, the disc often becoming slightly flattened, margin appressed against the stipe when young, glabrous, hygrophanous, when moist pale watery-gray on the disc, the margin whitish, translucent-striate, fading to cinereous and becoming sulcate; flesh thin, fragile, grayish, odor and taste mild; lamellae broad, arcuate or with a distinct decurrent tooth, rather distant, whitish to pale-gray; stipe 1–2.5 cm. long, 1 mm. thick more or less, equal, curved, tough and cartilaginous; glabrous, moist, concolorous with the pileus above or paler, faintly strigose where inserted on the bark; pileus trama with a very thin adnate pellicle, below it a region of inflated cells, the remainder of loosely arranged hyphae with very large cells; pleurocystidia not present; cheilocystidia imbedded and very inconspicuous, 20–25 × 6–8 μ, with short contorted projections scattered over the apex; basidia four-spored; spores 9–11 × 7–9 μ, broadly ovoid and pointed at one end, hyaline to pale bluish in iodine; gill trama wine red in iodine.

Scattered on cedar bark, Blue River, Ore., Oct. 22, 1937, No. *8046*-type, Oct. 24, No. *8159*; Kerby, Ore., No. 20, 1937, No. *8918*. It has been found only on cedar logs and trees which lacked a covering of bryophytes. It is often found in company with *Mycena brevipes* Murr. and resembles that species in color and stature, but differs in its broad gills, wider spores and small imbedded

roughened cheilocystidia. *Mycena corticola* has globose spores (FIG. 1, *C*) and is a much smaller agaric.

Mycena fragillima sp. nov. (FIG. 1, *G*; 2, *B–C*).—Pileus fragillimus, griseus, hydrophanus, demum cinereus; lamellae confertae vel subdistantes, adnatae, cinereae; stipes (3–7) 9–15 cm. longus, (1) 1.5–3 mm. crassus, fragillimus, pubescens; pleurocystidia et cheilocystidia 34–48 × 10–20 μ, late fusoidea, leva; sporae 7–9 (10) × 4–5 (5.5) μ.—Specimen typicum in Herb. Univ. of Mich. conservatum: Legit Orick, Calif., Dec. 3, 1935, A. H. Smith No. *3744*.

Pileus (5) 15–35 mm. broad, obtusely conic, becoming broadly campanulate to nearly plane in age, at first with a faint bloom, soon moist and watery, dark watery-gray and translucent-striate to the disc, becoming pale watery-gray or "hair brown" while still moist, hygrophanous and fading to very pale cinereous; flesh very thin, watery and fragile, grayish to pallid, odor and taste none; lamellae close in large caps, subdistant to distant in small individuals, adnate, pallid grayish with whitish even edges; stipe variable but long and slender (3–7) 9–15 cm. long, (1) 1.5–2 (3) mm. thick, usually decumbent, fragile, very pale watery-gray and minutely pubescent over all at first, soon polished and translucent, base white-strigose and sometimes slightly bulbous; pileus trama entirely of enlarged cells but with a thin adnate pellicle over the surface; pleurocystidia rare to absent, similar to cheilocystidia; cheilocystidia 34–48 × 10–20 μ, hyaline, smooth, broadly fusoid with an acute apex which becomes drawn out into a long narrow neck (15–25 μ long) in age, forming a broad sterile band along the gill-edge; basidia four-spored; spores 7–9 (10) × 4–5 (5.5) μ, pointed at one end, smooth, hyaline, bluish in iodine.

Gregarious on and around clumps of ferns, Booth, Ore., Nov. 24, 1935, No. *3620*, and Orick, Calif., Dec. 3, No. *3744*-type and Dec. 5, 1935, No. *3802*. Judging from descriptions, the cystidia and spores separate this species from *Mycena vitrea* (Fries) Quél. and also from *Mycena vitreata* Britz. The fine pubescent covering of the stipe may also be a significant character, although it is one which might readily disappear if the specimens developed in an exposed area. The extremely delicate texture of both large and small fruiting bodies is the outstanding macroscopic character.

Mycena madroñicola sp. nov. (FIG. 1, *A*).—Pileus 5–12 mm. latus, convexus vel subdepressus, brunneus demum avellaneus; lamellae distantes vel subdistantes, angustae vel latae, adnatae vel subdecurrentes; stipes 1–2 (3.5) cm. longus, 1 mm. crassus, pruinosus; cheilocystidia clavata, echinulata;

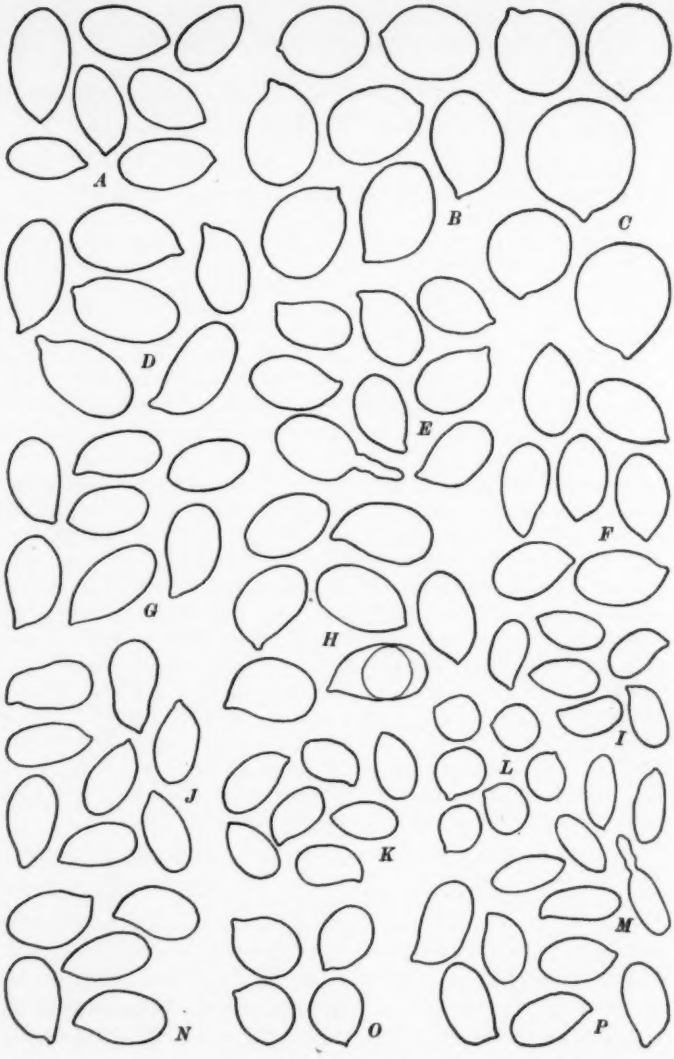

FIG. 1. *A*, seven spores of *Mycena madronicola*; *B*, seven spores of *Mycena corticola*; *C*, five spores of *Mycena corticola*; *D*, six spores of *Mycena sanguinolenta*; *E*, eight spores of *Mycena sanguinolenta*; *F*, five spores of *Mycena monticola*; *G*, seven spores of *Mycena fragillima*; *H*, seven spores of *Mycena subvitrea*; *I*, six spores of *Mycena pseudotenax*; *J*, eight spores of *Mycena pusilla*; *K*, seven spores of *Mycena piceicola*; *L*, six spores of *Mycena ulmicola*; *M*, six spores of *Mycena pelianthina*; *N*, five spores of *Mycena subplicosa*; *O*, four spores of *Mycena subcucullata*; *P*, six spores of *Mycena rutilantiformis*.

sporae 9–11 × 5–6 μ vel 7.5–9.5 × 4–5 μ.—Specimen typicum in Herb. Univ. Mich. conservatum: Legit Kerby, Ore., Nov. 26, 1937, A. H. Smith, No. *9093*.

Pileus 5–12 mm. broad, convex or with a somewhat flattened to subdepressed disc, not expanding, hoary when young, soon naked and in age more or less polished, moist, color "hair brown" to "cinnamon-brown" at first, fading to "avellaneous" or paler and with a whitish margin, at times "vinaceous-buff" or more grayish in age, when moist translucent-striate to the disc, becoming sulcate in age, margin at first appressed against the stipe; flesh concolorous, thin and pliant, odor when specimens were collected farinaceous but soon vanishing, no odor detected when specimens were unwrapped in the laboratory, taste mild; lamellae subdistant to distant, 14–18 (20) reach the stipe, narrow to moderately broad, broadly adnate but becoming toothed or more or less decurrent in age, color "tilleul buff" to pallid at all stages, edges even; stipe short 1–2 (3.6) cm. long, 1 mm. more or less thick, equal, base at first with a suboval bulb, tubular, concolorous with the pileus or paler, delicately frosted over all at first, base pruinose and inserted on bark as in *M. corticola,* apex pallid; pileus trama of three regions, a thin surface pellicle, a region of enlarged cells beneath it, and the remainder of floccose fllamentose tissue; basidia four-spored; spores 9–11 × 5–6 μ (in deposits), in revived material usually measuring 7.5–9.5 × 4–5 μ, narrowly ellipsoid and pointed at one end, hyaline, smooth, bluish in iodine; pleurocystidia none; cheilocystidia variable, forming a more or less conspicuous band or imbedded in the gill-edge and inconspicuous, 20–36 × 5–9 μ, clavate to capitate with short rod-like projections over the apex or the apex prolonged into a much branched contorted neck, sometimes smooth except for the branched apical portion.

Densely gregarious by the hundreds on bark of madroña trees in open places, after prolonged wet weather, Kerby, Ore., Nov. 26, No. *9093*-type, Cave junction, Ore., Nov. 29, No. *9224*, and Dec. 1, 1937, No. *9286*. Because of the large number of immature spores in mounts of revived material one is likely to conclude that the spores are smaller than they actually are, and for this reason measurements from both spore deposits and dried specimens are included. The species is closely related to *Mycena corticola*. The truly ellipsoid spores, however, form a specific distinction which would enable one to recognize it even if both were found growing together. Although weather conditions were favorable for the development of *M. corticola*, it was not encountered during the season of 1937.

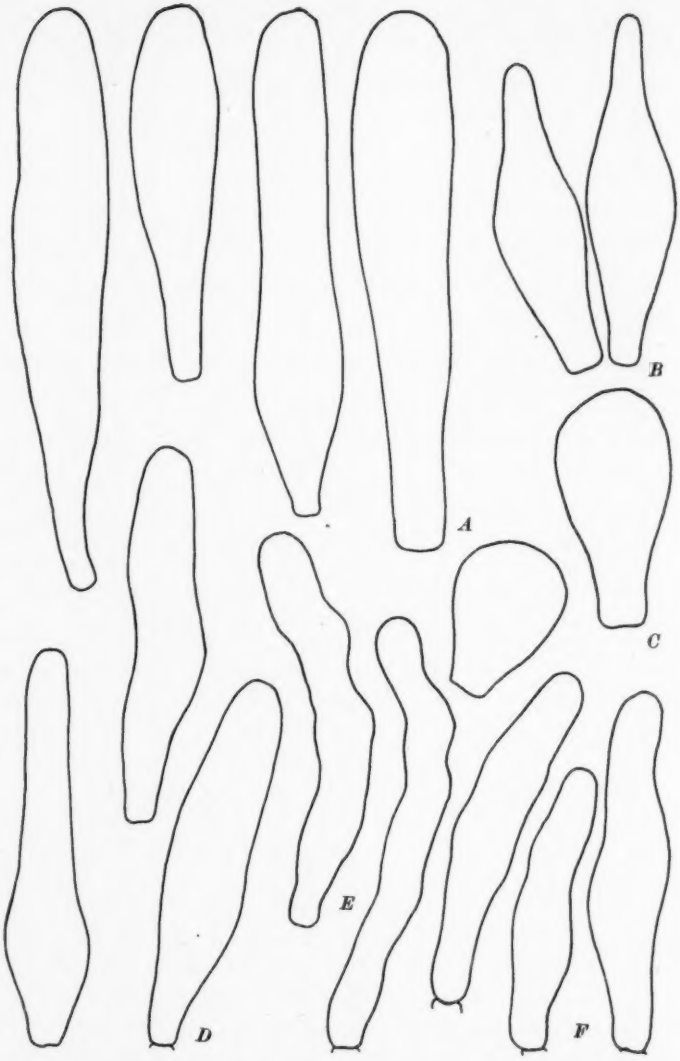

FIG. 2. *A*, four cystidia of *Mycena pseudotenax*; *B*, two mature cheilocystidia of *Mycena fragillima*; *C*, two immature cheilocystidia of *Mycena fragillima*; *D*, three cheilocystidia of *Mycena ulmicola*; *E*, two caulocystidia of *Mycena ulmicola*; *F*, three cheilocystidia of *Mycena subcucullata*.

Mycena monticola sp. nov. (FIG. 1, *F*).—Pileus 1–3 cm. latus, conicus demum campanulatus, laete incarnatus; lamellae adnatae, confertae, latae, pallide incarnatae; stipes 4–7 cm. longus, 1–1.5 (2) mm. crassus, laete incarnatus; sporae 7–10 × 4–5 μ; cheilocystidia 28–35 × 9–12 μ, echinulata.—Specimen typicum in Herb. Univ. Mich. conservatum: Legit prope McKenzie Pass, Ore., Oct. 18, 1937, A. H. Smith No. *7925*.

Pileus 1–3 cm. broad, conic, obtusely campanulate becoming either plane or umbonate, the margin appressed against the stipe when very young or more often conivent to it, frequently with a wavy uplifted margin in age, glabrous, moist and hygrophanous, "pompeian red" on the disc and "light jasper red" to "coral pink" toward the margin, in some the disc is not darker, fading to "flesh color," when moist translucent-striate, the margin slightly sulcate when faded; flesh thin, incarnate, brittle, no odor or taste; lamellae ascending adnate, close, 23–28 reach the stipe, moderately broad to broad, edges even and whitish or tinged "flesh pink" to "coral pink" when the faces are similarly tinted; stipe 4–7 cm. long, 1–1.5 (2) mm. thick, equal above a narrowed crooked base, hollow, juice watery and scanty, very sparsely fibrillose at the base, apex faintly frosted, soon naked and polished, "coral pink" over all when fresh, soon becoming sordid brown from the base upward and finally "blister" over the lower portion; pileus trama homogeneous beneath a somewhat differentiated adnate pellicle; pleurocystidia none; cheilocystidia 28–35 × 9–12 μ, clavate, with short echinulations over the enlarged portion; basidia four-spored; spores 7–10 × 4–5 μ, ellipsoid or pointed at one end, hyaline to pale-yellowish in iodine.

Gregarious under pine, McKenzie Pass, Ore., 3500 to 4500 ft. elevation, Oct. 18, No. *7925*-type, Oct. 21, No. *8014* and Oct. 23, 1937, No. *8104*. In its cystidia and color it resembles *Mycena rosella* somewhat, but differs from that species in its broader gills, lack of pleurocystidia, and lack of a colored gill-edge. The bright colors of *M. monticola* remind one of *M. clava* but the echinulate cheilocystidia separate it at once. *M. monticola* was found growing abundantly under yellow pine on the eastern slope of the Cascade Mts. and also on the western slope under pine. In both habitats it was second only to *M. rosella* in abundance.

Mycena piceicola sp. nov. (FIGS. 1, *K*; 3).—Pileus 2–3.5 cm. latus, obtusus demum late campanulatus, fuscus demum griseus; lamellae angustae, confertae vel subdistantes, adnatae, pallidae; stipes (2) 4–6 (8) cm. longus, 1.5–2 mm. crassus, strictus, griseus; cheilocystidia 25–34 × 6–10 μ, echinulata; sporae 6–8 (9) × 3.5–4 (5) μ.—Specimen typicum in Herb. Univ.

Mich. conservatum: Legit prope Siltcoos Lake, Ore., Nov. 13, 1935, A. H. Smith No. *3449*.

Pileus 2–3.5 cm. broad, ovoid to obtusely conic at first, becoming broadly convex or broadly ovoid in age with or without a wavy margin, pruinose when young, soon naked, surface even and lubricous when moist, color dark livid-gray to " fuscous " or " hair brown," the margin usually paler, fading to " drab " on the disc or sordid ashy-gray with a pallid margin, subhygrophanous and fading slowly, translucent-striate when moist; flesh watery-gray, thin, fragile, taste mild, odor subfarinaceous but faint and hardly distinctive; lamellae narrow, close to subdistant, adnate, whitish, then

FIG. 3. *Mycena piceicola* × 1.

pallid or grayish with pallid edges, intervenose; stipe (2) 4–6 (8) cm. long, 1.5–2 mm. thick, equal, strict, fragile, tubular, dark bluish-gray at very first and soon fading to " drab " or sordid below, with a pallid apex, covered with a hoary bloom but soon naked and polished and more or less translucent, the base white strigose and somewhat inflated; pileus trama with a thin surface pellicle, a region of enlarged cells beneath it appearing pseudoparenchymatous in tangenital section, the remainder of loosely interwoven hyphae; pleurocystidia not differentiated; cheilocystidia 25–30 × 7–11 μ, cylindric to clavate with obtuse short projections over the apices; basidia four-spored; spores 6–8 × 3.5–4.

or 7–9 × 4–5 μ, smooth, hyaline, ellipsoid, hyaline to bluish-gray in iodine.

Gregarious or in troops of hundreds of individuals under spruce, Siltcoos Lake, Ore., Nov. 13, 1935, No. *3449*-type; scattered under spruce, La Push, Wash., Oct. 25, No. *3324*, and at Lake Tahkenitch, Ore., Nov. 19, 1935, No. *3548*. Although fragile, the stipe does not split as in *M. dissiliens*. In many respects *M. piceicola* resembles *M. leptocephala* but the cystidia easily separate the two. It may perhaps be confused with large specimens of *M. plicosa*, but the lack of reddish-brown stains, narrower gills and thinner polished smooth stipe which does not break readily when one pulls the fruiting body from its attachment, all serve to distinguish it. There are differences in color also. I have never seen *M. piceicola* with a scalloped, crenate or sulcate-plicate margin of the cap although abundant fresh material of both has been seen. For further comments see *M. pusilla*.

Mycena pseudotenax sp. nov. (FIGS. 1, *1*; 2, *A*; 4).—Tenax: pileus 1–3 cm. latus conicus demum plano-umbonatus, lubricus, fuscus vel griseus; lamellae confertae, angustae, subsinuatae, cinereae; stipes 3–5 (6) cm. longus, 1.5–2 (3) mm. crassus, strictus, glabrus, lubricus, griseus, luteo-strigosus; pleruocystidia et cheilocystidia 50–60 (90) × 10–12 (15) μ, subcylindrica; sporae 5.5–7 (8) × 3.5–4 μ.—Specimen typicum in Herb. Univ. Mich. conservatum: Legit prope Belknap Springs, Ore., Oct. 23, 1937, A. H. Smith No. *8134*.

Pileus 1–3 cm. broad, obtusely conic or with a rounded apex when young, becoming expanded umbonate to nearly plane, the umbo usually broad and somewhat flattened, the margin often flaring in unexpanded individuals, glabrous, surface lubricous when wet, translucent striate to disc and the margin often creased or crenate in age, "fuscous" to pale watery-gray in young stages, at maturity pale watery gray over all or the margin whitish, fading to ashy-gray and appearing as if pruinose; flesh gray, thin but distinctly cartilaginous and thus causing the pileus to be very rigid, odor and taste mild; lamellae moderately close, 18–23 reach the stipe, adnate, becoming slightly sinuate, narrow to moderately broad and slightly ventricose at times, white becoming grayish in age, not becoming spotted, edges even and concolorous with the faces; stipe 3–5 (6) cm. long, 1.5–2 (3) mm. thick, equal, strict, cartilaginous-tough, glabrous, apex frosted from projecting cystidia, concolorous with pileus or paler, apex often whitish, base of stipe and surrounding fibrils whitish but soon becoming sordid

yellow; pileus trama with a very thin non gelationus pellicle over the surface, the region beneath of enlarged hyphae and quite compact, the remainder floccose-filamentose with narrower cells; pleurocystidia abundant, 50–60 (90) × 10–12 (15) μ, subcylindric with more or less rounded apices, arising in the subhymenium; cheilocystidia similar; basidia four-spored; spores 5.5–7 (8) × 3.5–4 μ, subellipsoid, pointed at one end, hyaline, smooth, bluish in iodine.

FIG. 4. *Mycena pseudotenax* × 1.

Gregarious on needle beds under fir and cedar, Blue River, Ore., Oct. 16, No. *7835*; South Fork of the McKenzie River, Oct. 20, No. *7967*; McKenzie Pass, under pine, Oct. 21, No. *8025* and *8038*; Blue River, under cedar and fir, Oct. 22, No. *8049*; Deschutes National Forest, Ore., Oct. 23, No. *8105*; Belknap Springs, Oct. 23, 1937, No. *8134*-type. In California it was found under brush at the edge of a pasture, Smith River, Nov. 17, No. *8823*, on Nov. 26 under fir near Patrick's Creek, No. *9071*, and on Nov. 28, 1937, under redwood, Prairie Creek State Park, Orick, Calif., No. *9152*. This was a common species at Blue River and easily recognized macroscopically by the cartilaginous-tough consistency, mild taste, yellow hairs at the base of the stipe and the slippery

feel. It might be mistaken for *M. tenax*, but the taste of the latter and its gelatinous stipe readily separate it without a microscopic examination. The yellow hairs at the base of the stipe at maturity, and the non-gelatinous stipe also separate it from *M. quiniaultensis*. *Mycena plumbeibrunnea* Murr. has smaller, acutely pointed cystidia on the sides and edges of the gills which measure 35–54 × 9–12 μ. These are longer at times due to the proliferated apex. They are broadly fusoid when young in contrast to the cylindric rounded cystidia of *M. pseudotenax*. In addition, the spores of *M. plumbeibrunnea* measure 8–10 × 5–5.5 μ. The latter should be carefully compared with *M. aetites* and *M. stannea* if fresh material can be found.

Mycena pusilla sp. nov. (FIG. 1, *J*).—Pileus 5–10 mm. latus, convexus, demum subplanus, lubricus, cartilagineus, pallide griseus, striatus; lamellae confertae, latae, adnatae, albidae; stipes 2.5–4 cm. longus, 1 mm. crassus, lubricus, griseus; cheilocystidia 26–30 × 7–12 μ, echinulata; sporae 7–10 × 5–6 μ.—Specimen typicum in Herb. Univ. Mich. conservatum: Legit prope Crescent City, Calif., Nov. 11, 1937, A. H. Smith No. *8620*.

Pileus 5–10 mm. broad, convex to obtuse or with a slightly flattened disc, in age more or less expanded plane or umbonate, disc pale watery-gray, the margin whitish, fading to pallid cinereous over all, surface hoary at first, glabrous and polished in age, lubricous when wet, striate to the disc when moist; flesh thin and membranous, grayish to pallid, odor and taste not distinctive; lamellae close, moderately broad, adnate, equal, white, edge even and concolorous; stipe 2.5–4 cm. long, 1 mm. thick, equal, tubular, whitish above, darker grayish-brown toward the base, with a bloom when real young, soon polished and lubricous but not viscid, tough; pileus trama with a thick subgelatinous pellicle, tissue beneath of somewhat enlarged cells; pleurocysitidia not differentiated, cheilocystidia 26–30 × 7–12 μ, clavate, hyaline, with short obtuse rod-like projections over the apex; basidia four-spored; spores 7–10 × 5–6 μ, broadly ovoid, hyaline, smooth, bluish in iodine.

In troops of hundreds of individuals on moss, South Fork of the McKenzie River, Ore., Oct. 20, 1937, No. *9797*, and under second growth fir, Siskiyou National Forest, Calif., Nov. 11, 1937, No. *8620*-type; Crescent City, Calif., Nov. 17, 1937, No. *8834*. This species puzzled me at first. It is most likely to be mistaken for the small form of *M. atroalboides*. When the two are compared, however, one becomes aware of certain differences, in fact,

the two impress one as being very different. *M. pusilla* is a lubricous tough little fungus whereas *M. atroalboides* is dry and fragile. When mounted in KOH the pellicle of the former gelatinizes appreciably and becomes 25–40 μ thick, that of the latter similarly treated measures 5–8 μ. *M. pusilla* resembles *M. constans* Peck in this character as well as in stature and color, but lacks a sharp odor. *Mycena subplicosa, M. piceicola* and *M. pusilla* can be distinguished from each other as follows: *M. subplicosa* has echinulate cystidia distributed over the faces of the gills as in *M. metata.* In the other two the cystidia are confined to the gill-edge. The pilei of *M. piceicola* measure 2–3.5 cm. and the whole plant is fragile. *M. pusilla* is smaller and very tough for a *Mycena.* The thick pellicle in KOH also distinguishes the latter from the former. *M. sepia* Lange may be the same as our short-stemmed form of *M. atroalboides.*

Mycena subaquosa sp. nov.—Pileus 2–3.5 cm. latus, convexus, demum subplanus, glabrus, hygrophanus, aquosus, lacteus, demum subcandidus; caro albo, odore et sapore valde raphanoideo; lamellae confertae, latae, albidae; stipes 4–9 cm. longus, 2–3 mm. crassus, albidus, equalis, glabrus; pleurocystidia et cheilocystidia 40–60 × 10–16 μ, fusoido-ventricosa; sporae 5–6.5 (7) × 2.5–3 μ.—Specimen typicum in Herb. Univ. Mich. conservatum: Legit prope Blue River, Ore., Oct. 15, 1937, A. H. Smith No. *7813.*

Pileus 2–3.5 cm. broad, obtuse to convex, becoming broadly convex to nearly plane or the margin somewhat recurved in age, glabrous and moist, hygrophanous, watery and dull white except for the milky-white disc, at maturity the disc tinged with watery-gray, fading and becoming shining whitish, striate to disc when moist, margin appressed against the stipe at very first but soon conivent to it; flesh watery-white, very soft and fragile, odor and taste very pronounced, resembling that of radish or more pungent; lamellae close, 26–32 reach the stipe, in three to four tiers, broad and ventricose (3–4 mm.) adnexed, concolorous with the pileus, edges even and whitish; stipe 4–9 cm. long, 2–3 mm. thick, white and translucent, hollow, equal, very fragile, glabrous except for sparse white hairs at the base, apex naked or faintly frosted; pileus trama with a scarcely differentiated pellicle, below it a region of compact radially arranged hyphae, the remainder floccose-filamentose, pleurocystidia 40–60 × 10–6 μ, fusoid-ventricose with rounded apices, hyaline; cheilocystidia usually shorter, 30–45 × 9–18 μ, broadly fusoid, with or without an elongated neck, smooth; basidia four-spored; spores 5–6.5 (7) × 2.5–3 μ, narrowly ellipsoid, bluish in iodine, smooth.

Gregarious under cedar on moss, Blue River, Ore., Oct. 15, 1937, No. *7813*-type. This species is similar to *Mycena pura* in its spores, cystidia and radish-like odor. Although *M. pura* was found everywhere in the conifer forests around McKenzie Pass during the 1937 season, it was consistently different from the specimens described above. In the whitish form of *M. pura*, according to my experience, the odor is not exceptionally strong, the colors are usually faintly pinkish or lilac on the disc and apex of the stipe, and the stature and consistency are the same as for the other forms of the species. In *Mycena subaquosa* the stature is more like that of *M. polygramma* than *M. pura*. This difference can not be considered a variation due to habitat because typical specimens of *M. pura* were collected in the same moss beds. The glabrous translucent stipe of *M. subaquosa* is quite different from the stipe of *M. pura*.

Mycena subcucullata sp. nov. (FIG. 1, *O*).—Pileus 1–6 mm. latus, conicus demum subcampanulatus, fuscus demum pallide griseus vel sordide ochraceus; lamellae subdistantes, latae, albidae; stipes 10–20 mm. longus, 0.5 mm. crassus, albidus vel griseus; pleurocystidia et cheilocystidia 26–34 × 8–12 μ; sporae 6–7 (8) × 5–6 μ; basidia bispora.—Specimen typicum in Herb. Univ. Mich. conservatum: Legit prope Warrensburg, N. Y., Sept. 12, 1934, A. H. Smith No. *779*.

Pileus 1–6 mm. broad, conic, campanulate or expanded plane with a conic umbo, umbo lacking in some, often more or less cucullate, colors fuscous on the disc or dark-gray, margin paler and finally whitish, disc also fading and often sordid ochraceous in age, sometimes white except for a sordid yellowish umbo, prominently striate when moist, often splitting readily in age; flesh thin, grayish, becoming white, rather cartilaginous, odor and taste not distinctive; lamellae subdistant to distant, broad, adnexed, white, thickish, edge even and concolorous; stipe 10–20 mm. long, 0.5 mm. thick, filiform but rigid, white to pale-gray, sordid below, rooting in moss on the bark of logs; pileus trama homogeneous below a thin pellicle, or the cells under the pellicle slightly enlarged; pleurocystidia scattered to rare, smooth, hyaline, saccate when young, subcylindric in age, 26–34 × 8–12 μ, cheilocystidia similar or more saccate, 25–30 × 9–14 μ, smooth, hyaline; basidia two-spored; spores 6–7 (8) × 5–6 μ, hyaline, smooth, hyaline to pale-bluish in iodine.

Gregarious on mossy logs, Warrensburg, N. Y., Sept. 12, 1934, No. *779*-type and No. *784*, also Sept. 14, No. *913*; Marquette,

Mich., Sept. 10, 1934, E. B. Mains, No. *34–150*. This is a small gray *Mycena* related in some respects to *M. epiphloea* (Fries) Sacc. but readily distinguished by its small spores and by the much smaller more saccate cystidia on the faces of the gills. It is almost identical in stature and appearance with gray forms of *M. mirata* Peck from which the cheilocystidia separate it at once.

Mycena subsanguinolenta sp. nov. (FIG. 1, *E*).—Pileus 10–25 mm. latus, conicus, sordide rubrus, demum incarnato-flavidus; lamellae rubro-marginatae; pleurocystidia nulla; cheilocystidia 28–35 × 6–9 μ; sporae 7–8.5 × 3.5–4 μ.—Specimen typicum in Herb. Univ. Mich. conservatum: Legit prope Blue River, Ore., Oct. 15, 1937, A. H. Smith No. *7809*.

Pileus 10–25 mm. broad, conic, becoming obtusely conic-campanulate, in age sometimes nearly plane but always with an abrupt obtuse umbo, hoary at first, soon glabrous and naked, moist, striate, in age sulcate to the disc, "burnt umber" near and on the disc, paler and near "vinaceous-buff" on the margin, in age a strong yellowish cast is evident throughout; flesh thin, yellowish or reddish under the disc, pliant, when cut exuding a watery orange-yellow latex, latex in the stipe blackish-red at first, later dull-orange, odor and taste mild; lamellae distant to subdistant, hooked, moderately broad, faces pale incarnate, edges dark reddish-brown; stipe 3–8 cm. long, 1–2 mm. thick, equal, fragile, hollow, base sparsely strigose with whitish hairs, apex hoary-pruinose, soon glabrous and naked, color pallid incarnate or concolorous with pileus margin, in age tinged yellowish; pileus trama with a thin surface pellicle, beneath it a region of more or less enlarged cells, the remainder floccose; pleurocystidia not differentiated; cheilocystidia numerous, 28–33 × 6–9 μ, with a sordid reddish brown content, somewhat fusoid with subacute apices; basidia four spored; spores 7–8.5 × 3.5–4 μ, smooth, hyaline, subovoid, bluish in iodine.

Densely gregarious under fir, Blue River, Ore., Oct. 14, No. *7775*, Oct. 15, No. *7809*-type; Lost Creek, Ore., Oct. 21, No. *8020*; and Crescent City, Calif., Nov. 2, 1937, No. *8329*. This species is separated from *M. sanguinolenta* by the smaller spores, lack of cystidia on the sides of the gills, and the more pronounced yellowish colors of the latex and also of both the pileus and stipe. Both species were observed in great abundance in California and were readily recognizable. Figure 1, *D*, illustrates the spores of *M. sanguinolenta*.

Mycena subvitrea sp. nov. (FIG. 1, *H*).—Pileus 1–3 cm. latus, conicus, glabrus, valde pellucido-striatus, atrofuscus vel cinereus; lamellae angustae, distantes, adnatae, cinereae, demum rufomaculatae; stipes 5–8 cm. longus, 1–2 (3) mm. crassus, pallidus, deorsum rufobrunneus; cheilocystidia 30–38 × 9–12 μ, subventricosa; sporae 8–10 (11) × (4) 5–6.5 μ.—Specimen typicum in Herb. Univ. Mich. conservatum: Legit prope Lost Creek, Ore., Oct. 21, 1937, A. H. Smith No. *8028*.

Pileus 10–30 mm. broad, obtusely conic, remaining so or becoming campanulate, the disc becomes somewhat flattened at times, black to " fuscous " on the disc, watery-gray toward the margin, conspicuously translucent striate to the disc, fading to ashy or blackish-gray and sulcate, hygrophanous, glabrous, surface even and moist when fresh; flesh very thin and fragile, dark watery-gray, odor and taste not distinctive; lamellae rather distant, narrow, bluntly adnate, dark-gray and staining reddish-brown in age or where bruised, edge even, pallid; stipe 5–8 cm. long, 1–2 mm. thick, equal, very fragile and watery, hollow, pale grayish white, glabrous, apex frosted, readily staining reddish-brown when bruised or in age; pileus trama with a thin nongelatinous pellicle over a region of globular cells which have brownish contents, the tissue below this of filamentous hyaline hyphae; pleurocystidia not differentiated, cheilocystidia inconspicuous, subfusoid, smooth, hyaline, 30–38 × 9–12 μ; spores 8–10 (11) × (4.5) 5–6.5 μ, ovoid, smooth, hyaline, bluish in iodine.

Gregarious under fir, Blue River, Ore., Oct. 15, No. *7811*; Lost Creek, Ore., Oct. 21, No. *8020*-type, Oct. 22, No. *8050*; Belknap Springs, Oct. 24, 1937, No. *8160*. The dark-gray, fragile, conspicuously striate pileus, pale fragile stipe, and tendency to stain reddish-brown when bruised or in age characterize it among the gray fragile Mycenas. It was found in company with *M. tenax* but was much less abundant. It is closest to *M. stannea* from which it is readily separated by the conspicuous broad blackish striations which extend to the disc, by the tendency of all parts to stain reddish brown, and by its more watery fragile consistency. It is also very close to *M. Murina* Murr. a species with pleurocystidia and one in which the lamellae and stipe do not change to reddish when bruised.

Mycena ulmicola sp. nov. (FIG. 1, *L*; 2, *D*, *E*).—Pileus 10–25 mm. latus, conicus demum umbonatus, fuscus, hygrophanus demum pallide cinereus, laceratus; lamellae confertae, angustae, candidae, adnatae vel adnato-decurrentes; stipes 2–3 cm. longus, 1.5–2 mm. crassus, equalis, valde pruinosus; cheilocystidia subcylindrica vel ventricosa, 40–50 (60) × 9–12 μ; sporae

3.5–4 μ, globosae.—Specimen typicum in Herb. Univ. Mich. conservatum: Legit prope New Hudson, Mich., June 8, 1938, A. H. Smith No. *9537*.

Pileus 10–25 mm. broad, obtusely conic, becoming umbonate with a flaring or recurved margin or sometimes nearly plane, with a narrow sterile margin which is curved in slightly at first but which soon becomes straight and more or less lacerated or split, "fuscous" on the disc at first and "buffy brown" toward the margin, becoming paler and often watery-gray before fading, hygrophanous, fading to "olive buff" more or less or almost white, in age often splitting radially, surface even to slightly rugose, translucent, striatulate when moist; flesh thin, pliant, watery-gray, odor and taste mild; lamellae crowded, 18–25 reach the stipe, three to four tiers of shorter lamellae are present, narrow, white, adnate to subdecurrent at times, readily seceding, edges even, pallid and sometimes crisped or wavy; stipe 2–3 cm. long, 1–1.5 mm. thick, equal, solid, brittle and easily broken, white-strigose around the base, densely pruinose to subpubescent over all, whitish above, pallid to grayish or sordid yellowish near the base in age; pileus trama without a differentiated pellicle, the surface region composed of a compact mass of radially arranged hyphae which are one or two times the diameter of the hyphae making up the remainder of the tramal body, in tangential section the surface region appears cellular due to the cut hyphal ends; pleurocystidia present only near the gill-edge and similar to the cheilocystidia; cheilocystidia 40–50 (60) × 9–12 μ, hyaline, subcylindric to subventricose with obtuse apices; caulocystidia very numerous; 40–50 × 8–10 μ, filamentous with obtuse apices, hyaline; basidia four-spored; spores 3.5–4 μ, globose to subglobose, smooth, hyaline, hyaline to faintly yellowish in iodine.

Gregarious on elm logs which have not lost their bark, usually on logs which are still quite sound, Pontiac, Mich., June 11, H. V. Smith (A. H. Smith, No. *6283*); June 15, 1937, No. *6303*, and near New Hudson, Mich., June 8, 1938, No. *9537*-type. The compact surface layer of the pileus made up of radially arranged hyphae doubtless explains why the cap splits so readily and presents such a torn appearance in age. The species is close to *M. atribrunnea* Murr. but differs in habitat and in the lack of pleurocystidia. *M. Kauffmani* is readily distinguished by its pseudorhiza and colored gill-edges.

MYCENA RUTILANTIFORMIS Murrill (FIG. 1, *P*) (*Mycena denticulata* Peck, not *Mycena denticulata* Quél., 1888; *Mycena pseudo-*

pelianthina Lange, Mycologia **26**: 9, 1934). Pileus (1.2) 2–7 cm. broad, convex, becoming broadly convex or in age at times with an elevated wavy margin, glabrous, moist to lubricous, hygrophanous, "natal brown" to "deep brownish drab" fading to near "avellaneous" or "vinaceous-buff," often paler and with a sordid yellowish cast, sordid purplish tints often persistent, margin striatulate when moist and frequently splitting in age; flesh moderately thick, yellowish to whitish, usually whitish in age, cuticle vinaceous in section, odor resembling that of radishes, taste similar or bitter and scarcely radish-like; lamellae close to subdistant, broad, adnate becoming sinuate or adnexed, seceding, intervenose, edges eroded to crenulate and sordid reddish-purple, faces "vinaceous fawn" or paler; stipe 3–8 cm. long, (3) 5–10 mm. thick, hollow, equal or base enlarged, somewhat longitudinally sulcate-striate, with scattered appressed purplish fibrils above, sometimes lacerate scaly from the broken cuticle, pallid grayish over all or the apex bright to sordid yellow beneath the purple fibrils, flesh grayish below, yellowish in the apex; pileus trama with a thin subgelatinous pellicle the cells of which may possess a reddish content, an indefinite region of enlarged cells beneath it, the remainder of floccose filamentous tissue (the pellicle may become washed or worn away in old pilei); pleurocystidia abundant, 60–80 × 9–15 μ, smooth, with a reddish content; cheilocystidia similar or shorter; basidia four-spored; spores 8–10 × (3.5) 4–5 μ, subovoid, smooth, hyaline, pale-bluish in iodine.

Gregarious on humus and debris under oak and hickory, Ann Arbor, Sept. 24, 1938, No. *11086*. A form was collected near Joyce, Wash., in 1935, No. *2565*, in which the characteristic odor and taste were lacking. Its spores measured 7–9 × 4–4.5 μ. The spores of the type at the New York State Museum, Albany, N. Y., measure 8–9 × 4–4.5 μ, and cystidia are abundant on the sides and edges of the gills. They measure 48–60 × 8–12 μ and are filled with a dark brownish sap. In all of their macroscopic characters the type specimens are very similar to dried fruiting bodies of *M. pelianthina*. The specimens Kauffman (2) determined as *M. denticulata* Peck are more properly referred to *M. Kauffmani* Smith. It is clear to me now, after observing *M. pelianthina* and *M. rutilantiformis* at various intervals over a ten year period that both are typically large fungi. Glatfelter's type collection happened to consist of exceptionally small individuals. Many of the specimens in my No. *11086* were well within the species as it was originally

described except that the pellicle was separable only in shreds. *M. rutilantiformis* differs from *M. pelianthina* in its broader spores, in the apex of the stipe which is usually yellowish at least within, and by the sulcate striations which are often present on the stipe. Lange gave a new name to the American species with yellow in the stipe and larger spores but otherwise like *M. pelianthina,* calling it *M. pseudopelianthina.* My studies indicate clearly that the latter name should be reduced to synonymy with *M. rutilantiformis.* Typical *M. pelianthina* also occurs in North America. During the past season it was collected in the same place on the same day—(No. *11087*)—as *M. rutilantiformis.* Because it is one of the easiest Mycenas to recognize and since the literature is full of reliable descriptions, it does not seem necessary to redescribe it here.

MYCENA SUBPLICOSA Karsten.—Pileus 10–20 mm. broad, obtusely conic, becoming campanulate or expanded-umbonate, densely frosted-pruinose when young, the margin paler or whitish, fading to "hair brown" on the disc and finally dark sordid gray with a cinereous margin, or the margin becoming sordid ochraceous in age, striate to disc when moist, more or less sulcate when faded; flesh thin, scarcely fragile, grayish to pallid, odor and taste mild; lamellae narrow to moderately broad in age, adnate, close, whitish becoming gray, strongly intervenose, edges pallid; stipe 3–4 cm. long, 1.5 mm. thick, equal, tubular, rigid-cartillaginous but moderately fragile (not splitting as in *M. dissiliens*), base white strigose, concolorous with the pileus or paler, glabrous, apex frosted when young; pileus trama with a thin adnate pellicle over a region of inflated cells, the remainder filamentose; pleurocystidia and cheilocystidia similar, 25–30 × 8–15 μ, saccate to pedicellate with a globose head, the upper portion covered with short rod-like projections, usually forming a broad sterile band on the gill-edge; basidia four-spored; spores 6–8 (9) × 3.5–4 μ, narrowly ellipsoid, hyaline, smooth, bluish in iodine.

Gregarious under spruce, La Push, Wash., Oct. 25, No. *3329*; along the Quillayute River near Mora, Wash., Oct. 26, 1935, No. *3341*; McKenzie Pass, Ore., Oct. 18, No. *7943*; South Fork of the McKenzie River, Oct. 20, No. *7980*, and at Blue River, Ore., Oct. 22, 1937, No. *8053*. In California it was found under second growth spruce at Crescent City, Nov. 17, 1937, No. *8836* and No. *8833*.

Karsten's species is here interpreted as having the same type of cystidia as *M. metata*. It differs from the latter in its dark colors and lack of an odor. The change to ochraceous which takes place in old caps is no way comparable to the brownish colors of the common form of *M. metata*.

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DESCRIPTION OF FIGURES

The drawings of the spores were made with the aid of a camera lucida and are magnified approximately 1500 times as reproduced. The drawings of cystidia are magnified approximately 900 times.

FIG. 1, *A*, seven spores of *Mycena madronicola*. *B*, seven spores of *Mycena corticalis*. *C*, five spores of *Mycena corticola*. *D*, six spores of *Mycena sanguinolenta*. *E*, eight spores of *Mycena subsanguinolenta*. *F*, five spores of *Mycena monticola*. *G*, seven spores of *Mycena fragillima*. *H*, seven spores of *Mycena subvitrea*. *I*, six spores of *Mycena pseudotenax*. *J*, eight spores of *Mycena pusilla*. *K*, seven spores of *Mycena piceicola*. *L*, six spores of *Mycena ulmicola*. *M*, six spores of *Mycena pelianthina*. *N*, five spores of *Mycena subplicosa*. *O*, four spores of *Mycena subcucullata*. *P*, six spores of *Mycena rutilantiformis*; 2, *A*, four cystidia of *Mycena pseudotenax*. *B*, two mature cheilocystidia of *Mycena fragillima*. *C*, two immature cheilocystidia of *Mycena fragillima*. *D*, three cheilocystidia of *Mycena ulmicola*. *E*, two caulocystidia of *Mycena ulmicola*. *F*, three cheilocystidia of *Mycena subcucullata*; 3, *Mycena piceicola* × 1; 4, *Mycena pseudotenax* × 1.

A NOTE ON PHLYCTIDIUM

J. S. Karling

In a recent note (**1937**) I pointed out that the spelling of Gobi's (**1879**) algal genus *Asterocytis* differs slightly from de Wildeman's (**1893**) chytrid genus *Asterocystis* and that there were no orthographic grounds for substituting *Olpidiaster* for the latter, as Pascher (**1917**) had maintained. Shortly thereafter Arwidsson (**1938**), however, showed that Berkeley and Broome (**1875**) had used the name *Astrocystis* for a group of ascomycetes, and since *Asterocystis* is but an orthographic variation of the latter, Berkeley and Broome's genus has priority over de Wildeman's. Pascher's viewpoint has thus been confirmed, but from other evidence than that which he presented.

In a study of the early mycological literature I have found another case of priority among the chytrid genera. In 1855 Braun established *Phlyctidium* as a sub-genus of *Chytridium* to include non-operculate species whose intramatrical absorbing system consists of an unbranched peg, knob, or short filament. A few years later Rabenhorst (**1868**) raised it to generic rank, and since that time it has been recognized as such by most students of the chytrids. A survey of the literature, however, shows that Wallroth used this name for a group of ascomycetes as early as 1833, and since *Phlyctidium* was thus established subsequent to Fries (1821–1832) *Systema mycologicum*, it has status and validity under the present rules of nomenclature. Braun was apparently unaware of Wallroth's genus, for in none of his writings have I been able to find any reference to it. The thirteen ascomycetous species included by Wallroth in *Phlyctidium* have since been gradually transferred to other genera as far as I am aware, and the genus is no longer recognized among the ascomycetes except as a tautonymy.

As has been pointed out by numerous investigators, it is very doubtful whether the chytrids included at present in *Phlyctidium* are sufficiently different from those of *Rhizophidium* to justify a

separate generic group. Schröter (**1889, 1897**) and Fischer (**1892**) do not recognize *Phlyctidium*, but Serbinow (**1907**), Minden (**1911–1915**), and subsequent workers believe it merits distinction. As noted above, its species differ from those of the other genus by the presence of a single unbranched knob, peg, or filament instead of a branched rhizoidal system. Obviously this is not a very fundamental generic character and of sufficient significance for separating the genus from *Rhizophidium*. Nor is it very practicable. When species occur on algal cells filled with degenerating plastids, starch grains, etc., the absorbing system may be completely obscured, and in such cases it is almost impossible to determine the genus to which a species belongs.

In recent years, however, various types of sexuality have been reported by Scherffel (**1925**), Sparrow (**1933**), and Couch (**1935**) for *Rhizophidium*, but sexuality is still unknown in *Phlyctidium*. It is accordingly probable that when the two genera are better known a more fundamental basis for separating or merging them may be found. None the less, for the time being and in the event that more fundamental evidence is found for the justification of a distinct genus, I am proposing the name **Tylochytrium** [1] nom. nov. as a substitute for Braun's *Phlyctidium* with the object of emphasizing the unbranched knob, peg, or filament which projects into the host cell.

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TWO SPECIES OF HYSTERIALES ON SMILAX

EDITH K. CASH

(WITH 2 FIGURES)

For many years confusion has existed regarding two species of the Hysteriales occurring on stems of *Smilax* in North America, so similar in macroscopic appearance, particularly in their early stages of development, that the distinction between them has not been clearly recognized. Both of these fungi have been referred to *Hysterium Smilacis* Schw. One is a species of *Gloniopsis,* called *Gloniopsis Smilacis* (Schw.) Underw. & Earle, or *Hysterographium Smilacis* (Schw.) Ellis & Ev.; the second a Hypodermataceous fungus generally known as *Hypoderma Smilacis* (Schw.) Rehm, although it would appear to belong more properly in the genus *Hypodermopsis.* In well developed material the *Gloniopsis* can be distinguished by its superficial fruiting bodies as contrasted with those of the *Hypodermopsis,* which remain beneath the epidermis even when mature. The most evident difference is in the character of the spores, which are hyaline and muriform in the former, brown and 3-septate in the latter.

The superficial resemblance of these two species and their growth on the same host has led to mixed collections, apothecia of both fungi being sometimes present on the same stem, only a few centimeters apart. It is apparent from the literature that the original Schweinitz specimen must have been such a mixed collection, and that some of the authors who examined his specimen found and described the one, some the other of the two species. An added source of confusion is the fact that some descriptions appear to combine characters of both fungi under a single name.

HISTORY

The original description of *Hysterium Smilacis* Schw. (**11**, p. 23, 1822), based on a collection from Salem, North Carolina, is

applicable to either of the two fungi, except that the dimensions of the hysterothecia are rather more typical of the *Hypodermopsis:*

H. sparsum lineare longitudinaliter situm atrum, minutissime tuberculatum, labiis laevibus tenuibus.

Non rarum ad emortuos ramos Smilacis rotundifoliae.—Longitudo 3 linearum. Labia parum elevata non striata.

Through the kindness of Dr. Francis W. Pennell, the writer had the privilege of examining a specimen in the Schweinitz Herbarium, which is part of the original gathering of Schweinitz from Salem. The hysterothecia present in this specimen are apparently all those of the *Gloniopsis;* however, there can be no doubt that both species were originally present in the collection.

Fries (**7**, p. 586, 1823) copied Schweinitz' description, with the addition of a few lines giving his own observations. His note "v.s." indicates that he had a part of Schweinitz' original Salem collection.

Hoc, ut plurima innata, primo obtuto superficiale videtur, sed quoad nostra spec. potius innatum, gracile, 2–3 lin. longum, labiis laevibus subnitidis prominulis, disco in clauso lineari. Ad emortuos ramos Smilacis rotundifoliae. Carolinae. (v.s.)

The superficial fruiting-bodies in Fries' specimen are presumably those of the *Gloniopsis,* while those described as slender, innate, 2–3 lines long, are more likely to belong to the *Hypodermopsis.* However it is impossible to assign the description positively to either of the two species, in the absence of any really distinctive characters.

The first mention of spore character in *Hysterium Smilacis* is given by Duby (**4**, p. 32, *pl. 1, f. 14,* 1861), in describing and illustrating material sent from New England by Curtis, which, however, he noted as probably immature. Duby described "sporas ovatas hyalinas nucleis subglobosis tribus faetes 2-seriales." Immature, hyaline, biseriate spores containing three nuclei might belong to either of the two fungi. The term "ovate" is more characteristic of *Gloniopsis,* since immature spores of the *Hypodermopsis,* exclusive of the gelatinous envelope, are fusoid.

Among the collections studied by Billings in obtaining data for his synopsis of the genus *Hysterium* (**1**, p. 630, *pl. 11, f. j,* 1871), he cites "authentic specimens in the Schweinitz Herbarium," so

that there can be little doubt that his description of *Hysterium Smilacis* Schw. is based on type material. The spores are said to be "colourless, subpyriform, .001–.0013 inch long, with a gelatinous envelope when young." His description, and more particularly his figure, clearly indicate that he was dealing with the *Hypodermopsis,* although immature, since the spores are still hyaline, one-septate, and surrounded by a conspicuous gelatinous sheath. This is, therefore, the first description of *Hysterium Smilacis* with which collections can be identified with certainty.

Rehm's Ascomycetes no. *318*[1] was issued as "Hypoderma Smilacis (Schweinitz sub Hysterium)." The combination is given in the same form in the published list of the exsiccati (**9**, p. 80, 1881), with a description of the asci and spores. The species is included in *Hypoderma* in spite of the fact that the spores are noted as four-celled. Examination of the specimen of Rehm's Ascomycetes No. *318* in the Mycological Collections of the Bureau of Plant Industry shows that the material contains both the *Gloniopsis* and the *Hypodermopsis,* but apparently Rehm found only the latter.

The first European record of *Hysterium Smilacis* is that made by Thümen (**12**, p. 24, 1881), who lists the fungus without description on *Smilax aspera* and *S. mauritanica* from Portugal. Oudemans (**8**, p. 1188–1189, 1919) and Saccardo (**10**, p. 789, 1883) record the same hosts. No European specimen has been examined by the writer, and no other reference has been found to collections from elsewhere than the United States.

Under the name of *Hypoderma Smilacis* (Schw.) Rehm, Saccardo (**10**, p. 789, 1883) copied Fries' description, with the addition of notes on the asci and spores, evidently translated from Rehm: "ascis clavatis, crasse tunicatis, ramuloso-paraphysatis, 75 × 18, octosporis; sporidiis elongato-fusoideis, obtusiusculis, 4-cellularibus, 2–4-nucleatis, medio subconstrictis, 27 × 8, hyalinis." There is no indication that Saccardo examined Schweinitz specimens.

The next record of an examination of Schweinitz' material of *Hysterium Smilacis* is that made by Ellis and Everhart (**6**, p. 709,

[1] Rehm: Ascomyceten *318, Hypoderma Smilacis* (Schweinitz sub Hysterium). Ad smilaces varias emortuas, Newfield (New Jersey), N. Amerika, 12/ 1875, Ellis, 1876.

1892). Their description is a composite of characters of both fungi, partly copied from Schweinitz, partly based on Ellis' collections, but seems to apply in the main to the *Gloniopsis*. The spores are described as " biseriate or inordinate, clavate-oblong or clavate-fusoid, yellowish hyaline, 3–5-pseudoseptate, one or two of the inner cells divided by a longitudinal septum, 12–20 (mostly 15) × 4–5 μ or, including the gelatinous envelope, 7 μ wide." It is obvious from this description of the spores that Ellis found the *Gloniopsis* in the Schweinitz specimen. Since Ellis and Everhart considered *Gloniopsis* as a subgenus of *Hysterographium*, the species is listed in the North American Pyrenomycetes (**6**, p. 709) as *Hysterographium Smilacis* (Schw.) Ellis & Ev.

The combination *Gloniopsis Smilacis* was made by Underwood and Earle (**13**, p. 196, 1897), with the observation: " This is evidently a *Gloniopsis* and not a *Hypoderma*, where it is placed by Rehm and Saccardo."

Wilson and Seaver, Ascomycetes and Lower Fungi no. 5 was issued under the name *Gloniopsis Smilacis* (Schw.) and the combination published (**14**, p. 49, 1907) in the annotated list of the first fascicle of their exsiccati set. *Hysterium Smilacis* Schw., *Hypoderma Smilacis* (Schw.) Sacc. and *Hysterographium Smilacis* (Schw.) Ellis & Ev. are given as synonyms of the new combination, which is, however, antedated by the publication of the same name by Underwood and Earle in 1897. The specimen of Wilson and Seaver Ascom. and Lower Fungi 5 in the Mycological Collections is the *Gloniopsis*.

Hysterium Smilacis is not included among the species discussed by Bisby (**2**, 1932) in his studies of type specimens of certain Hysteriales.

To summarize, it may be seen from the above citations that Ellis, Underwood and Earle, Wilson and Seaver, and probably Duby, on the one hand, are dealing with the *Gloniopsis*, while Billings, Rehm, and Saccardo had under discussion the *Hypodermopsis*.

TAXONOMY

Since the descriptions of Schweinitz, Fries, and Duby fail to show to which of the two species present in the type collection they

refer, that of Billings (**1**, p. 630, *pl. 11, f. j*) in 1871 is the first recognizable account of the fungus. It may therefore be permissible to consider the fungus which he described as the type of *Hysterium Smilacis*. The genus *Hypoderma* in Darker's classification (**3**, p. 15, 1932) is applied to species having one-celled, hyaline spores. In the fungus under consideration, the spores are clearly two-celled in a very early stage, later becoming brown and eventually four-celled; it can not, therefore, be retained in the genus *Hypoderma*. The only genus in the Hypodermataceae described with dark, three-septate spores is *Hypodermopsis* Earle (**5**, p. 345, 1902), of which *H. Sequoiae* Earle is the type species. Part of the type collection of this species,[2] deposited in the Mycological Collections by the courtesy of Dr. David H. Linder, has been examined. While the spores are darker in color and the paraphyses are more distinct in *Hypodermopsis Sequoiae* than in the fungus on *Smilax*, the two species agree so closely in general structure that *Hysterium Smilacis* Schw. may be included in Earle's genus.

If the fungus described by Billings is to be considered as the type of *Hysterium Smilacis* Schw., it becomes necessary to rename the *Gloniopsis*, which is therefore given the specific name "*Ellisii*."

1. **Hypodermopsis Smilacis** (Schw.) comb. nov. (FIG. 1, *A*; 2, *A*).

Syn.: *Hysterium Smilacis* Schw. sec. Billings, Am. Nat. **5**: 630, *pl. 11, f. j.* 1871 (= *Hysterium Smilacis* Schw. Syn. Fungorum Carol. Super. p. 23, 1822, p. p.).

Hypoderma Smilacis (Schw.) Rehm, Ber. Naturf. Ver. Augsburg **26**: 80, 1881.

Hysterothecia subepidermal, 0.5–1 × 0.2–0.3 mm., occasionally confluent up to 2 mm. long, scattered or closely grouped, usually arranged lengthwise along the stems, straight or rarely slightly curved, obtuse, membranous, dull-black, smooth, opening by a slit, nearly closed even when mature, closely covered by the blackened epidermis and showing only a narrow portion along the slit; asci broad-clavate, obtuse at the apex, short-stipitate, 65–80 × 20–24 μ;

[2] *Hypodermopsis Sequoiae* Earle, sp. nov., Pacific Slope Fungi no. *81*, distributed by C. F. Baker.

spores long-fusoid, at first hyaline and two-celled, and surrounded by a conspicuous gelatinous sheath 2.5 μ thick, becoming brown and finally 3-septate, 20–27 $\times$ 7–9 μ, constricted at the middle septum, the upper portion usually slightly broader than the lower; paraphyses hyaline, filiform, branched and interwoven, soon conglutinated into a dense yellowish epithecium; basal layer thin, hyaline; covering layer above and at sides black, 10–15 μ thick, adnate to the epidermal cells, 35–55 μ thick including the epidermis.

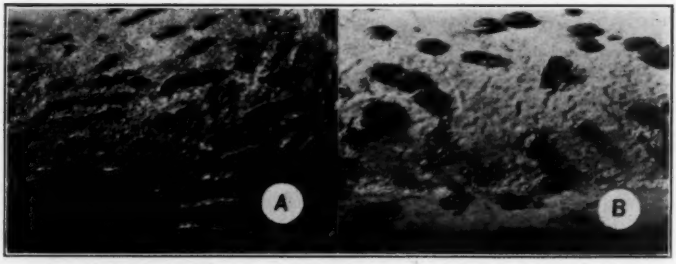

FIG. 1. *A*, hysterothecia of *Hypodermopsis Smilacis*, × 5; *B*, of *Gloniopsis Ellisii*, × 4.

On dead or dying stems of *Smilax rotundifolia*, and *Smilax* sp., New York, Pennsylvania, New Jersey, Maryland, Virginia, North Carolina, and Louisiana.

Exsiccati: Thüm. Myc. Univ. *662*; Rehm Ascomyceten *318*, p. p.

2. **Gloniopsis Ellisii** nom. nov. (FIG. 1, *B*; 2, *B*).

Syn.: *Hysterium Smilacis* Schw. Syn. Fungorum Carol. Super. p. 23, 1822, p. p.; Duby, Mém. Hyst. p. 32, *pl. 1, fig. 14*, 1861 (?).

Hysterographium (*Gloniopsis*) *Smilacis* (Schw.) Ellis & Ev., N. Am. Pyren. p. 709, 1892.

Gloniopsis Smilacis (Schw.) Underw. & Earle, Ala. Agr. Exp. Sta. Bull. **80**: 196. 1897.

Gloniopsis Smilacis (Schw.) Wilson & Seaver, Jour. Myc. **13**: 49, 1907.

Hysterothecia at first subepidermal, then emerging and becoming superficial, elliptical to elongate, 0.4–0.7 $\times$ 0.3–0.5 mm., irregularly scattered lengthwise or less often crosswise on the stems, black, smooth to slightly roughened, opening by a narrow slit, lips some-

times faintly striate, rather acute at the ends; asci cylindrical-clavate, often curved or irregularly constricted, obtuse with wall thickened at the apex, gradually narrowed toward the base, 65–80 × 15–18 μ; spores subpyriform to clavate, hyaline, muriform, slightly constricted near the center, the upper portion broader than the lower, 4–6-septate, with the center cells longitudinally divided, surrounded when young by a narrow, inconspicuous, hyaline, gelatinous envelope which soon disappears, 15–22 × 5–8 μ; paraphyses filiform, numerous, repeatedly branched, interwoven, forming a

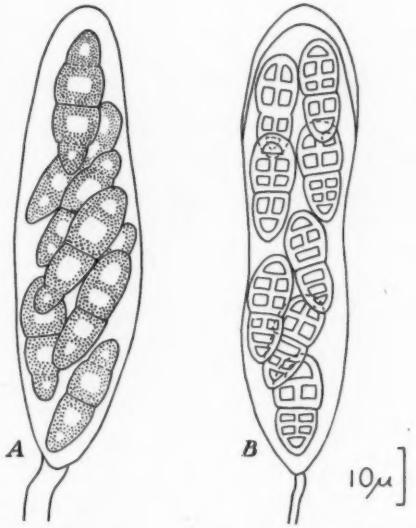

FIG. 2. *A*, ascus of *Hypodermopsis Smilacis*; *B*, of *Gloniopsis Ellisii*.

brownish epithecium; hypothecium thin, pale brownish, underlying and covering cortex black, carbonous, 45–65 μ thick below, 60–75 μ thick above.

On dead or dying stems of *Smilax* sp., Rhode Island, New York, New Jersey, Maryland, Virginia, Alabama, Florida, and Louisiana.

Exsiccati: Wilson & Seaver, Ascom. and Lower Fungi *5*; Ellis & Ev. N. Am. F. *2375*; Ellis F. Nova-Caesareenses *66*; Rehm Ascomyceten *318*, p. p.

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type specimens in the Philadelphia Academy of Sciences and the Farlow Cryptogamic Herbarium, Cambridge, Mass.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

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THE GENUS HYPOCHNUS AND FRIES'S OBSERVATIONES

DONALD P. ROGERS

(WITH 6 FIGURES)

Before any student of the fungi can safely shape into final form monographic work on *Corticium*, on *Peniophora*, on *Coniophora*, especially on *Tomentella*, or on any of a number of lesser genera related to these, there is a purely nomenclatorial question which must be given what will for him be its final answer: the question of the application of the Friesian generic name *Hypochnus*. Such a ghost cannot be laid by incantation, nor even by solemn pronouncement of its inconsequence; rare is the problem solved by the wisdom of the ostrich. Yet within the memory of persons now living one [1] who would wish to be accounted a man of science submitted to an American scientific society the thesis that its members might well "leave nomenclature to arm-chair botanists." It is conceivable that in an effete and inane scientific utopia where all substances could be treated in the universal abstraction of a single formula, all processes expressed in a single transcendent equation, and all organisms comprised in a single Platonic pattern there would no longer be a place for the particularizing now sometimes felicitously achieved in nomenclatorial niceties. But so long as the imperfection of the sciences compels their students to deal with lesser truths than the ultimate universal, looseness in scientific nomenclature will be the agent of obfuscation, and the signature of unscientific looseness of thought. For the achievement of nomenclatorial precision in one minute corner of mycology, and thus as an infinitesimal step towards the attainment of the utopia in which nomenclatorial laziness would be something less than the shirking of responsibility, there is here presented a study of this single generic name.

[1] "Viros, a quorum receptis opinionibus subinde abii, non ubique nominavi. Non enim animus erat contradicendi, sed rite exponendi naturam" (22).

That the name *Hypochnus* Fries has been applied, with full show of validity, to several quite diverse groups of fungi is largely attributable to the extraordinary ambiguity of Fries's own conception of his genus. In his first treatment, in his Observationes (**8**), *Hypochnus* includes (1) *H. sereus,* a species which according to the classification of the Thelephoraceae current in this country (**6**) must be placed in *Peniophora;* (2) a *Corticium, H. coeruleus;* (3) *H. fumosus,* a member of the homogeneous group of Thelephoraceae with minutely asperulate spores which, variously assigned to *Corticium* sect. *Humicola* Bourdot & Galzin and to *Hypochnus* sensu Burt, belong in neither, but in their own genus, *Cristella* Patouillard; (4) two members, including the type, *H. ferrugineus,* of the genus *Tomentella* Patouillard; (5) *H. isabellinus,* a member of the highly characteristic genus *Botryobasidium* Donk (**20**); (6) *H. olivaceus,* which Bourdot and Burt have agreed in declaring a cystidiate *Coniophora* (*Coniophorella*); and (7) two dubious species, *H. aureus* and *H. helvolus,* which may possibly have been imperfecti or lichens. *Hypochnus* of the Systema [2]—"*Hypochnus* Fr. Ehrenb." (**10**); that is, *Hypochnus* of Fries as emended by Ehrenberg—has only the name and the doubtful *H. aureus* in common with that first genus. Although in the Epicrisis (**11**), twenty years after the publication of the first *Hypochnus* (**8**), it was given as Fries's judgment that two of the three species included in the second (**10**) were "Genuini," according to his own final decision (**12**) they are not Thelephoraceae, but lichens. Further, it is recorded that Fries himself appreciated the confusion which involved his genus. In the thesis Genera hymenomycetum (**16**), whose authorship he subsequently acknowledged in the citation "Fr. Gen. Hymen." (**11**, p. 315 et passim), *Hypochnus* is described as "Genus varia ratione interpretatum et interpretandum"—at once a history and a promise of ambiguity.

[2] The circumscription of *Hypochnus* forever established, under the Rules, by incorporation in the Systema mycologicum actually was first published by Fries in the Systema orbis vegetabilium (**9**). There he wrote, evidently of the earlier *Hypochnus* of the Observationes, "Species nostrae plurimae excludendae." But because no species were described for *Hypochnus* in the Systema orbis vegetabilium it is not there, but in the Systema mycologicum, that one must look for the valid and definitive publication.

It is no wonder that from such beginnings later mycologists have worked out in various directions. "*Hypochnus* as given in Engler & Prantl's 'Die Natürlichen Pflanzenfamilien' [first edition and, more's the pity, second also] is the presentation of a purely academic scheme of Schroeter's as to how the lower Hymenomycetes ought to be classified to have a family Hypochnacei" (**5**). Schroeter's *Hypochnus* (**21**) is exactly such a mixture of forms as the genus of the Observationes: it includes species of *Corticium, Peniophora, Botryobasidium, Cristella, Aleurodiscus,* and *Hymenochaete;* the first species, *H. bisporus,* is a *Corticium,* according to present standards. Schroeter's genus and family are both characterized by cylindric basidia and loose texture—and by nothing else. Brefeld's incredible Tomentellei (**2**), which includes *Pachysterigma* (*i.e., Tulasnella*) and *Exobasidium* along with something called *Hypochnus,* arose as a result of his similarly attributing to looseness of basidial arrangement great importance as a principle of limitation, and to other microscopic characters, even less than Schroeter. Karsten defined "*Hypochnus* Fr." not as Fries had done, by the vague character of texture alone, but by "Hymenium tomentosum. Sporae aculeatae" (**14**). Since Karsten and the rest have treated this *Hypochnus* as an emended Friesian genus, its type must be chosen from among Fries's species; of these there is included in Karsten's *Hypochnus* but the one, *H. olivaceus,* the last of the series described in the Observationes, and a member not of the first, but of the sixth, of the modern genera included by Fries in his first *Hypochnus.* But *H. olivaceus* is the type also of the later genus *Coniophorella;* then although by description Karsten's *Hypochnus* is the rough-spored group treated under the same name by Burt, by inevitable typification it is synonymous with, and takes precedence over, the smooth-spored, cystidiate *Coniophorella.*[3] *Hypochnus* in the sense of

[3] An additional complication is introduced by Bresadola's observation (**3**) that Fries's herbarium contains both a smooth- and a rough-spored *H. olivaceus.* Bresadola would blow hot and cold from the same mouth by considering each fungus *H. olivaceus* Fries, as though the other did not exist. But clearly there can be but one *H. olivaceus* Fries; an incongruous specimen must stand as evidence of a misdetermination. As described in the Observationes, the species in question is "olivaceus, margine fimbriato albido"; when next described by Fries, in the Elenchus, it was characterized

Patouillard (**18**) is defined even more clearly than Karsten's but quite differently: "Hymenium ténu, *floconneux,* tomenteux ou subpulvérulent . . . spores ovoïdes, lisses, incolores"; his first species is *H. serus,* the same as, or at least approximately homonymous with, Fries's first. But just as Karsten's definition was broad enough to include such alien species as *H. fumosus,* so Patouillard's was readily applied to fungi as different as *H. longisporus* (a highly characteristic *Peniophora*) and *H. Solani* (*Botryobasidium*).

All these then are the genus *Hypochnus.* The recent incorporation into the International Rules of the type concept affords the possibility of a final solution of this tangle—and also of more nomenclatorial confusion in connection with *Hypochnus* than ever arose from anyone's "academic scheme"; and the possibility has already been seized upon. The proposal (**4**) to conserve *Hypochnus* with the type fixed as "*H. serus* Fr."[4] must, if accepted, inevitably lead to such wholesale name-changing as to eclipse completely the timid revisions of O. Kuntze and N. J. McGinty. For the species generally considered to be *H. serus*[5] has in its hymenium sterile bodies which Bourdot consistently considered to be cystidioles, the proper ornament of a *Corticium,* and Burt, for equally cogent reasons, to be cystidia, the chief character of *Peniophora.* With *H. serus* the type of *Hypochnus* it would be neces-

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also by "Setulae sparsae, obscuriores." Neither description applies to any rough-spored form at present known; both describe *Coniophora* (or, *Coniophorella*) *olivacea,* which must consequently be presumed to be *H. olivaceus.* Whatever Karsten thought about the matter, then, Fries's *Hypochnus,* emendavit Karsten, whose type is Fries's *H. olivaceus* (*i.e., Thelephora olivacea* Fries ex Persoon, Myc. Eur. **1**: 143. 1822; Fries, Elenchus **1**: 197. 1828) is typified by a *Coniophora* (*Coniophorella*). This kinship of *H. olivaceus* with *Coniophora* seemed probable to Persoon also, as long ago as 1822 (l.c.).

[4] *Thelephora sera* Persoon, Myc. Eur. **1**: 151. 1822. *Hypochnus serus* (Persoon) Karsten, Myc. Fenn. **3**: 320. 1876 (*T. sera* Persoon, Syn. Meth. Fung. 580. 1801. *H. sereus* Fries, Obs. Myc. **2**: 278. 1818). *T. bombycina* Sommerfeldt ex Fries, Elench. **1**: 211. 1828. . . . Thus there was no *H. serus* published by Fries, unless *sereus* be regarded as one of his lesser lapsus calami.

[5] The uncertainty whether *H. serus,* necessarily based on Persoon's *Thelephora sera,* is the fungus usually identified with *H. serus* (*i.e., Corticium serum* sensu Bourdot & Galzin, *Peniophora Sambuci* sensu Burt) or that commonly known as *Corticium bombycinum,* scarcely recommends this proposal as a step toward nomenclatorial stability.

sary for those who see it as did Bourdot to transfer to *Hypochnus* the two hundred or so described species of *Corticium*, while for those who agree with Burt, *H. serus* would attract unto itself an

FIGS. 1–6.

equally extensive series of forms out of the then synonymous genus *Peniophora*. Be it noted that such a solution of the problem of *Hypochnus*, while it arbitrarily disposes of all the conflicting earlier conceptions by invalidating them, can itself scarcely be

clarified by legislation; it is to be hoped that no congress will ever set itself to decide whether the cystidioles of *H. serus* are cystidia or not. In America the prevalent idea of *Hypochnus* is Burt's, which, like Karsten's from which it is derived, sets this off from other thelephoraceous genera "by strictly resupinate habit [and] . . . by rough-walled to echinulate spores." Except that a too rigorous application of this definition has brought into the genus species wholly unrelated to the majority of its components (*H. Peniophoroides* Burt, *H. Tulasnelloideus* (Höhnel & Litschauer) Rea), this is a good, practicable grouping. Also, it may, on the ground of usage, claim support of those to whom usage is tremendously important and for whom American usage is alone definitive. It so happens that there are several usages, of which this is but one, as a consequence of which situation conformist and recusant alike must appeal to the Rules; and it so happens that from the standpoint of the rules the name *Hypochnus,* applied to this or to any group of fungi, is indefensible.

As Donk (**7**) points out, and as Burt's citation (**5**) barely fails to indicate, these applications of *Hypochnus* to fungus genera depend for their validity on the existence of a second edition of Fries's Observationes mycologicae, published in 1824 and so not invalidated, as is the 1815–1818 edition, by the rule that nomenclature for the Hymenomycetes does not go back of 1821. Pritzel (**19**) is the first to refer to such an edition; he gives a citation as minutely circumstantial as that of the first edition, dating the two volumes 1824 and 1828. Lindau & Sydow (**17**) and Burt cite the work with equal confidence; but it appears that their authority is Pritzel, rather than actual examination of the volume. On the other hand Krok (**15**) reports his failure to find such a book in any of the great European libraries, and Donk (**7**) writes, "*eine Ausgabe aus dem Jahre 1824 . . . gibt es nicht!*"—italics and exclamation point being equally his. Enquiries directed by the writer to Miss E. M. Wakefield, Dr. J. H. Barnhart, and others brought further expressions of doubt concerning the existence of this nomenclatorially valid edition, and for a time it appeared to be probably no longer in existence. But finally a copy was discovered, in the library of the Massachusetts Horticultural Society, and borrowed for examination. The title-page of the first volume reads

as in Pritzel: "Cum tab. VIII aeneis color. Edition nova . . . MDCCCXXIV." The extraordinary thing is that apparently all that is new about the edition is the title-page; for the pages of the text are minutely identical—not as they would be if the first edition had been closely followed in setting up the second, but as they could be only when printed from the same individual types. To illustrate, from photographs of pages from the two editions: Volume I, p. 79 (FIG. 3, 4)—l. 6: *u* in *Bull.* is raised above the line; the lower left-hand corner of *H* in *Herb.* is cut off; l. 7: the second *i* in *sterilioribus* scarcely has made an impression; l. 12: *fi* in *firmus* is short at the bottom; p. 156 (FIG. 5, 6)—l. 5: *riac* in *coriaceum* is slanted below the rest of the line, as is *m* in *pulverulentum*; l. 7: *b* in *Tab.* is above the line; l. 8: *e* and the second *i* in *abiegnis* are weak, and *S* in *Sueciae* is cut off at the bottom; l. 15: the second *t* in *digitato* is weak; l. 21: *s* in *ramis* has the upper curve closed, as in a figure 9. Equally exact correspondences between the two editions occur wherever they are sought, in both the first and the second volumes. Thus in volume II, p. 280—l. 5: *s* in *sco* is raised above the line; l. 9: only the *P* in *Pulchra* is an italic letter; l. 19: *l* in *Theleph.* is an italic letter. So much for the text. The original title-page of volume 1 of the first edition (FIG. 1) is printed, as it should be, on the same paper used throughout the volume; that of the second edition is on paper of approximately the same color, but thinner and softer, and therefore could not be taken, even in the absence of the evidence already presented that the associated text was printed years before the date of the title-page, to be an original part of the volume into which it is bound.[6] Furthermore,

[6] According to the custom of the time, the printer in setting up the work commenced not with the first printed page, but with the first page of the body of the text; the title-page and any prefatory material were left until the end, to be printed if possible on any blank portion of one of the last sheets. Apparently there was at first no prefatory material for the Observationes; and apparently the single leaf bearing the title-page was printed on the sheet next to the last, for the gathering folded from that sheet, signature O, has only fourteen pages, 209–222, while all the others have the full sixteen (eight leaves). In the copy in the Farlow Library the title-page here illustrated (FIG. 1) is inserted immediately before signature A, and printed on the same paper as the rest of the volume. A copy in the writer's library, similarly dated 1815, must represent a later state, to which certain prefatory material was added: on its title-page appears a somewhat fuller text than on the original; following are a page of dedications, a

the original title-page of volume II of the *first* edition is bound into the *second* in its proper place, still bearing the date 1818. Probably Pritzel, in dating volume II of the second edition 1828, was attempting to correct this 1818; there is no apparent reason why the two volumes of the second edition, if this were such a one, should not be issued together.[7] The plates of the "second edtion" are not actually eight colored, but four colored and four not, as in the first. A copy in the Lloyd Library of the second edition, from which photographs of certain pages were compared with the first edition, shows the same minute correspondences already described (and the same title-page as the Massachusetts Horticultural Society copy), and is therefore a second example of this incomprehensible reissue. As yet no report has appeared of the attitude of the International Botanical Congresses with respect to the nomenclatorial legitimacy of a work reissued with a new title-page bound in; for the present it is permissible to regard the second edition as invalid. One curious aspect of the matter is that personal notes of Dr. Farlow's, inside the front cover of his copy of the first edition, establish that the Massachusetts Horticultural Society's copy of the second, with which he had compared it, existed in its present form earlier than 1873, long before there was any attempt to fix on 1821 as a starting-point, and before the publication of Pritzel's note. The advantage of producing a spurious first edition is clear enough to any bibliophile; but a spurious second—! Another oddity occurs on the substituted title-page; possibly by someone a hint can be derived from the (presumably) inadvertent substitution of "edition" for "editio."

promise of the early appearance of the second volume, and three pages of errata; all of this makes up a gathering of two pairs of leaves bound in to replace the original title-page; this gathering is printed on thinner, softer, yellower paper than the rest of the volume. The title-page of volume I of the "second edition" (FIG. 2) is a single sheet, bound in as was the original; difference in paper shows that it was not printed with the rest of the volume, in the place provided, along with the seven leaves of signature O. The text was printed in 1815; this title-page, presumably in 1824.

[7] The Friesian bibliography edited by Elias Fries's sons (13) gives the single date 1824 for an "ed. nova." If, as here suggested, Pritzel's 1828 should be 1818, his citation is of just such a patched-up affair as is here described. Whether T. M. & R. Fries examined the title-page of volume II does not appear in the record.

Whatever the story of the book, it is clear that Pritzel's second edition exists, and that it is as useless as the first for the purpose of establishing *Hypochnus* in a sense acceptable to anyone. Karsten's so-called emendation of 1881 (**14**), whether seen in the light of the type concept or treated more tenderly, as when it constituted the basis for Burt's work, must then fall. For neither here where it would bolster up the prejudice of a professional mycologist, nor where it is done apologetically to make the work of mycologists acceptable to the mycologically unlearned, is it strictly permissible to typify an ancient genus by a species quite unrelated to any of those included in the original valid publication. It is manifestly impossible to emend *Hypochnus* of the *Systema,* a genus composed, so far as known, exclusively of lichens, so as to make it tenable for Thelephoraceae. If emendations have nomenclatorial validity, the one published by Fries himself in the Epicrisis, where the lichen members of an enlarged *Hypochnus* are set apart as *Genuini,* would surely have precedence over Karsten's; if the emendation were to be (even though it cannot be) a recasting of the nomenclatorially non-existent *Hypochnus* of the Observationes, Bonorden's much earlier treatment (**1**), lacking species of *Hypochnus* as defined by Karsten and Burt, might well take precedence over Karsten's. . . . Here then is the present legal status of the name; any attempt to give it standing by conservation would seem to be scarcely profitable; the name already means so many things that it means nothing. Clearly the best procedure would appear to be that already informally recommended by Miss Wakefield, to consider *Hypochnus* a nomen ambiguum, in accordance with the Rules, and to put it permanently beyond the reach of misguided attempts at conservation or revival. Even though the 1824 "publication" were declared legitimate, no other way out of the tangle could be found as satisfactory as this.

There remains the question of the correct name for the fungi treated by Burt under *Hypochnus. Tomentella* Patouillard is clearly valid—and as the Hymenomycetes are now treated, is valid irrespective of the ultimate disposition of *Hypochnus,* so long as the latter is not deliberately conserved against it; *Tomentella* is valid without the conservation proposed by Donk (**7**). But the genus *Caldesiella* is properly not separable from *Tomentella*; in

any natural arrangement of the fungi the two must be regarded not as members of two distinct families, Thelephoraceae and Hydnaceae, but as only slightly different aspects of a single genus; *Caldesiella* is clearly more closely related to some species of *Tomentella* than are other Tomentellae. *As matters now stand,* then, *Tomentella* should be reduced to synonymy under the earlier *Caldesiella.* But this is exactly what should not be done; not only is *Tomentella* a large genus and *Caldesiella* a small one, but in addition *Caldesiella* will for some time be regarded by many as a member of the Hydnaceae; to treat the Tomentellae under this name would lead to further confusion.

In order "to avoid disadvantageous changes in the nomenclature of genera by the strict application of the Rules" (**4**), it is therefore hereby proposed to conserve *Tomentella* Patouillard 1887 (Type: *T. ferruginea*) against *Caldesiella* Saccardo 1877. Such conservation of course in no way affects the status of *Caldesiella* as an autonomous genus; for those mycologists to whom it is distinct, *Caldesiella* retains its name; since the two genera do not have the same type, the reduction of either to synonymy can proceed only from taxonomic, not from nomenclatorial, considerations.

To summarize: An 1824 edition of Fries's Observationes mycologicae, in which *Hypochnus* is sometimes thought to have been validly published, is spurious; the two copies extant are specimens of the 1815–18 edition with a new title-page tipped in. The valid publication of the genus is that in the *Systema mycologicum*; and this *Hypochnus* is composed of lichens. The name *Hypochnus* is then not available for any of the various groups of fungi to which it is applied. *Hypochnus* Fries emendavit Karsten is *Coniophora* or *Coniophorella*; *Tomentella* is the valid name for *Hypochnus* sensu Burt; *Peniophora* or *Corticium* for *Hypochnus* sensu Patouillard; *Hypochnus* of other authors is incapable of polite characterization.

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EXPLANATION OF FIGURES

Photographs of pages from Fries's *Observationes*. FIG. 1, 3, 5, from Ed. 1, vol. 1, copy in the Farlow Library. FIG. 2, 4, 6, from Ed. 2, vol. 1, copy in the library of the Massachusetts Horticultural Society.

ISOPLANOGAMETES IN BLASTOCLADIA

ERNST A. BESSEY

Blastocladia has been considered by some students of the genus as lacking sexual reproduction. On the other hand Butler (1) and Kanouse (3) considered the thick-walled resting spores to be oogones, perhaps parthenogenetic in function. The latter author described an antherid-like structure at the end of a slender filament and considered it to be a true antherid.

The writer in October 1935, obtained numerous colonies of *Blastocladia Pringsheimii* Reinsch by suspending fruits of *Rosa* and *Crataegus* in the Red Cedar River and in a pool in the Beal Botanical Garden, both on the campus of Michigan State College. This is the commoner species obtained in this manner but *B. globosa* Kanouse is also found some autumns. The colonies appeared as grayish tufts on the surface of the fruit, 0.1 to 0.5 mm. in diameter and height. Each such tuft consisted of many plants whose branches were more or less entangled, all embedded in a bacterial slime. When the fruits were washed under a rather strong stream of tap water most of this slime was removed and the colonies were picked off for study and mounted in distilled water. Numerous plants of various sizes showed an abundance of the thin-walled sporangia and a few plants showed numerous thick-walled sporangia (resting-spores of some authors). The plants bearing the thick-walled sporangia were in all cases smaller than those bearing the thin-walled ones. No plants were producing both types of sporangia. After a few minutes active swarm-spores began to be visible in the thin-walled sporangia and quickly emerged. No swarm-spores developed in the thick-walled sporangia under observation.

The escaping swarm-spores swam in all directions but soon began to approach one another in pairs. Because of the entangled plants it was impossible to determine whether the two forming each pair came from different plants or from the same plant. Many such pairs were observed. The beginning of fusion was

observed in several cases and in one case the process was followed until fusion was completed. The pairing cells came in contact laterally, not apically or at the flagellate end. A serious illness prevented the writer from following the fate of the united cells. In 1936, 1937 and 1938 *Blastocladia* was obtained again but in only one case were swarm cells observed and these did not show any signs of pairing.

In view of the fact that the very closely related genus *Allomyces* shows sexual union by heteroplanogametes (**2**, **4**), this occurrence of isoplanogametes in *Blastocladia* is not surprising. Many things remain to be studied: Does any such alternation of sexual and non-sexual stages occur as in *Allomyces;* what environmental conditions favor this union, etc.?

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THE HOST RANGE OF SAPROLEGNIA PARASITICA [1]

WESLEY N. TIFFNEY [2]

(WITH 2 FIGURES)

Although various species of the Saprolegniaceae have been reported on many different fish, in no case has the host range of these species of fish mold been determined experimentally under controlled conditions on an extensive series of accurately identified hosts. A survey of the literature on the subject discloses that although a composite host range can be compiled from the several references, such a host range is based not upon controlled experiments and accurate determinations but merely upon random records of various hosts parasitized by species of the Saprolegniaceae. Because these reports are numerous and most of them are of little value unless compared with others, the essential facts of the pertinent observations they contain are presented in Table I. It is true that a few writers (Smith, **23**; Stirling, **24**; and Clinton, **7**) have reported infections appearing on large numbers of fish but these reports lack definite certainty of the identity of the parasite, while in nearly every case the host is mentioned by its common name, a practice which is confusing since one species of fish is often known by different common names in different regions.

It seemed desirable, therefore, by means of extensive inoculations under controlled conditions, to investigate the host range of

[1] Contribution from the Laboratories of Cryptogamic Botany and the Farlow Herbarium, Harvard University no. 167.

[2] The writer wishes to acknowledge his indebtedness to Professor William H. Weston, Jr., under whose direction this work was done, for his invaluable encouragement and guidance, and to Dr. David H. Linder, who made many helpful suggestions during the course of the investigation. The writer is also greatly indebted to Dr. O. E. Sette, Mr. R. A. Nesbit and Mr. R. A. Goffin, of the U. S. Bureau of Fisheries; to Mr. Arthur Kitson of the Massachusetts State Fisheries; and to Mr. O'Brien of the Boston City Aquarium, for their generous services in aiding the writer in collecting and for providing aquarium facilities for the fish used in these studies.

TABLE I

HOST RANGE OF THE PARASITIC MEMBERS OF THE SAPROLEGNIACEAE COMPILED FROM PREVIOUS REPORTS

Author	Reference number	Parasite	Host
Agersborg, H. P. K.	(1)	*Saprolegnia ferax*	*Salvelinus fontinalis*
Bangham, R. V.	(2)	*S. parasitica*	Large mouth black bass, small mouth black bass
Bennett, J. H.	(3)	*Saprolegnia* sp.	Goldfish
Berkley, M. J.	(4)	*S. ferax*	Fish eggs
Blanc	(5)	*S. ferax or Achlya prolifera*	Pickerel
Chiappelli, R.	(6)	*Saprolegnia* sp.	Carp
Clinton, G. P.	(7)	*S. ferax* or *S. mixta*	Small mouth black bass, rock brook trout, catfish, buffalo fish, dogfish, paddle fish, moon eye, gars, suckers, black bass, white bass, yellow bass, calico bass, yellow perch, grayling, pike, pike perch, sheepshead, sand pike, bream, blue sunfish, warmouth
Graff, P. W.	(8)	*S. parasitica*	Carp
Lund, A.	(14)	*S. parasitica*	*Leusicus*
Murray, G.	(15)	*S. ferax*	Salmon
Patterson, J. H.	(16)	*Saprolegnia* sp.	Salmon
Robinson, E. M.	(19)	Fish mold	Salmon fry
Rosenberg, A.	(20)	Fish mold	Brook trout
Ryder, J. A.	(21)	Fish mold	Shad (*Alosa sapidissima*)
Schnetzler, J. B.	(22)	*Achlya prolifera* and *Saprolegnia ferax*	Pickerel
Smith, W. G.	(23)	*S. ferax*	Trout, eels, lampreys, flounders, minnows
Stirling, A. B.	(24)	Fish mold	Roach, dace, godgeon, pike perch, perch, salmon
Unger, F.	(26)	Fish mold	Tadpole, bull pout
Walentowicz	(27)	*Achlya Nowickii* and *Saprolegnia monoica*	Carp

one of these Saprolegniaceous pathogens, to determine the factors influencing infection, and to ascertain the resulting symptoms of disease on the various hosts.

The pathogen used was a sub-culture from the type of *Saprolegnia parasitica* Coker. This species was chosen because it had been found by the writer to be the most serious pathogen to fish in this region (Tiffney, **25**) and also because the use of the subculture of the type eliminated all possible question of the identity of the parasite.

Fish and amphibians of as many different species as possible were obtained for use as hosts. A list of these animals and the sources from which they were obtained is given in Table II. The

TABLE II

THE SPECIES OF TELEOSTEI AND AMPHIBIA USED IN EXPERIMENTS TO DETERMINE HOST RANGE, WITH THE LOCALITIES FROM WHICH THEY WERE OBTAINED

Family species[3]	Common name	Locality
TELEOSTEI		
Siluridae		
Ameiurus nebulosus Le Sueur	Catfish	South Weymouth, Mass.
Catostomidae		
Erimyzon sucetta Lacépède	Sucker	South Weymouth, Mass.
Cyprinidae		
Crassius auratus L.	Goldfish	Boston, Mass.
Semotilus atromaculatus Mitchill	Dace	Guilford, Conn.
Anguillidae		
Anguilla chrysypa Rafinesque	Eel	South Weymouth, Mass.
Salmonidae		
Salmo irideus Gibbons	Rainbow trout	Nashua, N. H.
Salmo fario L.	Brown trout	Nashua, N. H.
Salmo sebago Girard	Salmon	Nashua, N. H.
Poecilliidae		
Fundulus heteroclitus L.	Chub	Boston, Mass.
Lebistes reticulatus Peters	Guppy	Boston, Mass.
Esocidae		
Esox reticulatus Le Sueur	Pickerel	Falmouth and South Weymouth, Mass.
Centrarchidae		
Pomoxis sparoides Lacépède	Calico bass	Falmouth, Mass.
Eupomotis gibbosus L.	Sunfish	Falmouth, Mass.
Micropterus salmoides Lacépède	Black bass	South Weymouth, Mass.
Percidae		
Perca flavescens Mitchill	Yellow perch	Falmouth, Mass.
Serranidae		
Morone americana Gmelin	White perch	Falmouth, Mass.
AMPHIBIA		
Salamandridae		
Triturus viridescens Rafinesque	Newt	Rindge, N. H.
Ranidae		
Rana pipiens Schreber	Frog	Lexington, Mass.

fish were taken from their native waters by means of seines and transported in cooled, insulated tanks to the aquaria at the Boston City Aquarium or at the Harvard Biological Laboratories in Cambridge. During the course of the experiments the fish were kept in isolated tanks which were supplied with a constant flow of water. The chubs and other small fish were kept in 6″ battery

[3] Teleostei determined and arranged after Jordan and Evermann (**11, 12**); Amphibia after Pratt (**18**).

jars, the somewhat larger fish in aquarium tanks 16″ × 8″ × 10″, while the bass and other very large active fish were kept in concrete tanks 2½′ × 4½′ × 2½′. Since it was found that the Cambridge municipal water was toxic to trout and salmon, experiments on these fish were conducted at the Boston City Aquarium.

Inoculation of the fish was accomplished by inducing the parasitic *Saprolegnia* to form large numbers of zoöspores in the tanks. Zoöspores were produced at the outset of the experiment by using the method advocated by Klebs (**13**), Pieters (**17**) and others, which consisted essentially of growing the fungus for three days or more in a nutrient solution (0.5 per cent aqueous solution of peptone) until mats of mycelium were produced, washing these thoroughly to remove all adhering nutrient, and placing them in the fish tanks. This treatment resulted in the production of enormous numbers of zoöspores in a very short period of time. Continual zoöspore production was accomplished during the course of the experiment by placing hemp seed inoculated with the fungus in the tanks at intervals of three days. Thus the fish were thoroughly subjected to the possibility of infection, by continuous exposure to a larger number of zoöspores than would normally be found in nature. Since infection in nature is normally accomplished by zoöspores, as will be shown in a subsequent paper, this procedure gave what was considered to be a valid test of the susceptibility or immunity of the hosts.

Each experiment was carried on over a period of two weeks. As soon as an animal died from the disease it was removed from the tank, the identity of the parasitiç fungus was verified by comparison with the type culture, and the death was recorded. In order to determine the part played by injury in susceptibility to infection, experiments were performed both on uninjured fish and on fish that had been injured by the removal of a few scales.

For the purpose of maintaining a control for each experiment, several fish were placed under the same conditions as the experimental fish but were not exposed to fungus. If at any time during the course of the experiments the fish in these control tanks appeared abnormal, possibly because of toxic substances in the tap water or because of some other undetermined agent, the experiment in progress was stopped and repeated on a new group of

fish. It was of course appreciated that spores of *Saprolegnia parasitica* or some other species of *Saprolegnia* or *Achlya* could come through the tap water and parasitize the fish. However, since the fish were subjected to heavy overdoses of *Saprolegnia parasitica* zoöspores and since the writer always verified the identity of the fungus recovered from the diseased fish by comparing it with that used in inoculation, the possibility of a species other than *S. parasitica* parasitizing the fish was practically excluded; and if, as is extremely improbable, *S. parasitica* did come in through the tap water from outside rather than from the thousands of zoöspores in the tanks, it did not vitiate the experiment.

The degrees of susceptibility shown by various species of hosts are presented on a percentage basis in Table III. These figures represent the incidence of death caused by the disease, and in most cases were compiled from observations on 25 or more individuals. However, in the cases of *Erimyzon sucetta, Anguilla chrysypa* and *Esox reticulatus* only 10 individuals of each could be obtained, while only 5 individuals each of *Pomoxis sparoides* and *Micropterus salmoides* were available.

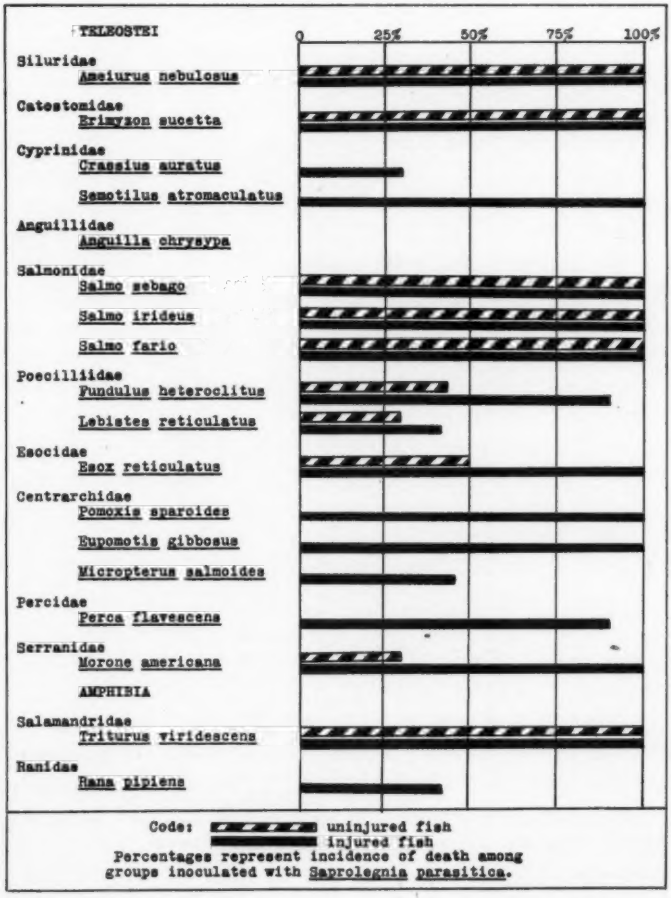
DISCUSSION

An examination of the results presented in Table III brings out certain points of interest. First, it is evident that the parasite was capable of attacking a wide range of hosts, for it parasitized frogs and salamanders as well as fish of nine different families. There was, however, a marked difference in the resistance of different species to the disease. For instance, *Ameiurus nebulosus, Erimyzon sucetta, Esox reticulatus, Triturus viridescens* and the species of the Salmonidae used, apparently had a very low resistance to this disease; *Semotilus atromaculatus, Pomoxis sparoides, Eupomotis gibbosus, Morone americana, Perca flavescens* and *Fundulus heteroclitus* showed a somewhat greater resistance; while *Crassius auratus, Lebistes reticulatus, Micropterus salmoides* and *Rana pipiens* had a rather high resistance to the disease. Only *Anguilla chrysypa,* of all the animals used, might be said to be immune to the fungus, for this fish, even when injured, did not contract the disease. This last finding at first might seem to be a direct contradiction of that of Smith (**23**), who

observed *Saprolegnia ferax* parasitizing eels in England. However, since it is now believed that the European eel and the American eel are different species, and since the parasite found by

Table III

The host range of Saprolegnia parasitica and the effect of injury on the susceptibility of the host.



Smith was *S. ferax* while the present writer worked with *S. parasitica,* the two cases are not necessarily contradictory, although they offer an interesting comparison.

Second, it is evident that injury greatly lowered the resistance of the majority of the fish to *S. parasitica,* a point of interest since fish under natural conditions probably sustain frequent injuries, particularly fish such as salmon which migrate up rivers to spawn. This effect of injury may explain the wide-spread epidemics observed by Huxley (**9**), Murray (**15**), and Patterson (**16**) among fish in the process of migrating to their spawning grounds.

The symptoms of the disease were identical on the various species of fish used in these experiments. The first indication of an infection was given by the behavior of the fish itself, which, evidently irritated, rubbed the infected region by vigorously swimming against some object. Even before the fungus itself was visible the infected area could be distinguished from the surrounding normal tissue by the abnormal protrusion of scales. The fungus appeared later as a small tuft growing in the center of this region, and the area increased in size as the fungus spread. It was noticeable that at about the time the infected area became 10 to 15 mm. in diameter the activity of the fish was lowered, and at the same time numerous other small infected spots appeared (FIGS. 1, 2).

During the second to fourth day after inoculation, depending upon the individual resistance to the disease, the trunk muscles seemed to become more and more paralyzed until the fish was incapable of moving its body and finally of moving even its fins, and in this state floated to the surface of the water or lay on the bottom of the tank. An autopsy showed that all internal organs appeared to be in a normal state and that the heart might still be beating. These latter observations are in accord with those made by Huxley (**10**).

Another point of interest is that the fish have been observed to eat living mycelial mats of *Saprolegnia parasitica,* and apparently suffer no harm from it. Agersborg (**1**) believes that fish suffer from intestinal infections of *S. ferax* brought about by eating the fungus. During the course of these experiments the present writer has repeatedly examined the intestines of fish that have eaten fungus. These examinations have been made from one to several days after infection might have occurred and although in some cases in gross appearance the intestinal contents somewhat

resembled hyphae, microscopic examination showed that there was no intestinal infection by *S. parasitica.*

It is of further interest to note that death was not due to smoth-

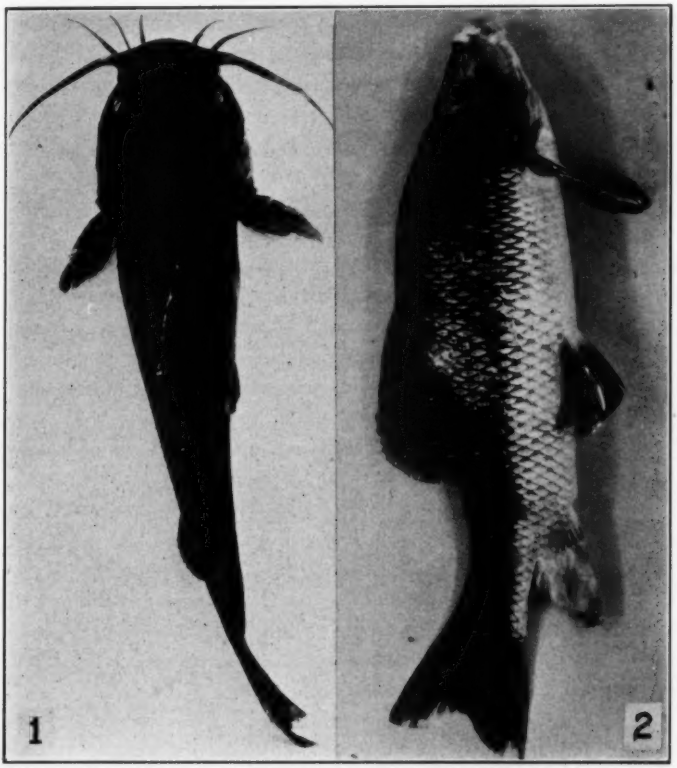


FIG. 1. *Ameiurus nebulosus,* showing the extent of infection four days after inoculation with *Saprolegnia parasitica.* Note the sharply defined circular lesions, characteristic of the disease on this host. (½ natural size.) FIG. 2. *Erimyzon sucetta,* showing the extent of infection with *Saprolegnia parasitica* four days after inoculation. Note the raised lesion just under the dorsal fin, and also the lesions on the head, tail fin and anal fin. (½ natural size.)

ering. In all the cases observed by the writer there has been but one instance in which the hyphae of the parasite grew on the gills of the host. This was an exceptional epidemic among Necturi

following injuries received during shipment, an epidemic so severe that the fungus, in contrast to its usual occurrence in small patches, completely covered the animals. Moreover, the symptoms of smothering, according to the writer's observations, were different from the symptoms of the *Saprolegnia* disease since fish undergoing asphyxiation continually came to the surface of the water for oxygen and might in extreme cases rapidly dash back and forth at the surface of the water. Such actions were never observed in the case of fish infected with *Saprolegnia parasitica*. The writer's conclusion that death was not due to smothering is in agreement with that of Huxley (**10**), who stated that he had never observed the parasite on the gills of fish.

The symptoms of this disease seem to indicate that there are three possible causes of death. First, the fungus may cause death by the destruction of tissues; second, some sort of toxic materials may be formed which cause paralysis and death; third, the fungus may destroy areas of protective epidermis, thus permitting free passage of water and in all probability causing dilution of body fluids in fresh-water species or dehydration of body fluids in salt-water types, and consequently bringing about basic isotonic upsets. It is the writer's purpose to discuss these three possibilities in subsequent papers.

Other authors (see Table I) have observed that members of the Saprolegniaceae are capable of parasitizing a large number of species of fish. However, as far as the writer knows, this paper gives for the first time the host range of one species of *Saprolegnia*, determined experimentally under controlled conditions on accurately identified hosts. It adds the following species of fish and amphibians to the list of hosts of *Saprolegnia parasitica* Coker: *Ameiurus nebulosus, Erimyzon sucetta, Crassius auratus, Semotilus atromaculatus, Salmo sebago, S. irideus, S. fario, Fundulus heteroclitus, Lebistes reticulatus, Esox reticulatus, Pomoxis sparoides, Eupomotis gibbosus, Micropterus salmoides, Perca flavescens, Morone americana, Triturus viridescens* and *Rana pipiens*.

SUMMARY

The host range of *Saprolegnia parasitica* Coker was investigated by means of controlled inoculations on accurately identified fish and amphibians of as many species as could be obtained.

1. It was found that there was a marked difference in the resistance of various species of hosts to the pathogen. *Ameiurus nebulosus, Erimyzon sucetta, Esox reticulatus, Salmo sebago, S. irideus, S. fario* and *Triturus viridescens* were found to have a very low resistance to the disease. *Semotilus atromaculatus, Pomoxis sparoides, Eupomotis gibbosus, Morone americana, Perca flavescens* and *Fundulus heteroclitus* showed a somewhat greater resistance, while *Crassius auratus, Lebistes reticulatus, Micropterus salmoides* and *Rana pipiens* had a high resistance to the disease. Only *Anguilla chrysypa* was found to be immune.

2. Injury greatly lowered the resistance of the majority of the species of hosts to the disease.

3. The symptoms of the disease were identical for the various species of fish used in these experiments.

4. Fish were frequently observed to eat living mycelial mats of *Saprolegnia parasitica* but apparently suffered no harm thereby and did not develop intestinal mycosis.

5. Except for one aberrant case, there was no evidence that the death of the host was caused by smothering.

6. From observations made during the course of this investigation the writer suggests three possible causes of death to the host: (*a*) the destruction of tissue, (*b*) the formation of toxic materials, and (*c*) the dilution or dehydration of body fluids resulting from the destruction of areas of protective epidermis.

7. The following species of fish and amphibians were added to the previous records of hosts of *Saprolegnia parasitica* Coker: *Ameiurus nebulosus* Le Sueur, *Erimyzon sucetta* Lacépède, *Crassius auratus* L., *Semotilus atromaculatus* Mitchill, *Salmo sebago* Girard, *S. irideus* Gibbons, *S. fario* L., *Fundulus heteroclitus* L., *Lebistes reticulatus* Peters, *Esox reticulatus* Le Sueur, *Pomoxis sparoides* Lacépède, *Eupomotis gibbosus* L., *Micropterus salmoides* Lacépède, *Perca flavescens* Mitchill, *Morone americana* Gmelin, *Triturus viridescens* Rafinesque and *Rana pipiens* Schreber.

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MYCOLOGICAL NOTES. III

C. L. SHEAR

(WITH 1 FIGURE)

10. SPHAERIA CONFERTA Schw. Syn. Fun. Car. 45, No. 187. 1822

Schweinitz described this species as follows:

187. *conferta* Sz.

S. simplex aggregata globosa truncata subinculoque repento radiato-fibroso aterrimis.

In cortice Lauri Benzoin emortuo leviter innascens. Subiculum e filis crassiusculis, stellatim in cortice repentibus; ubi sparsa occurrit sphaeria, eleganter centrum filorum occupat. Sphaeriae confertae, truncatae, disco impresso, demum collapso, ut in Sph. cupulari. Ostiolum minutum, deciduum. Sphaerulae granulosae.

In Syn. Fun. Bor. 211, No. 1508, 1832, he made the following record, changing the name:

1508. 363. *S. confertula,* L.v.S., Syn. Car. 187, F. 286 (conferta) rariter etiam in Pennsylv.

The exact identity of this species has been in doubt up to the present time. Cooke, Grevillea **15**: 81. 1887, has the following note:

Byssosphaeria (*Amphisphaeria*) *conferta,* Schwein. Sacc. Syll. No. 4277. Herb. Berk. *9603.*

Sporidia uniseptata, fusca, utrinque obtusa, medio constricta, .012 × .004 mm.

Whether the specimen referred to by Cooke as "Herb. Berk. 9603" is part of a Schweinitz specimen in the herbarium at Kew or not we do not know. In any case the description of the spores does not agree with any fungus found by others who have examined portions of Schweinitz' specimens, and the name used by Cooke can not be regarded as a synonym of Schweinitz' *Sphaeria conferta.* Schweinitz changed the name to *confertula* as indicated in Syn. Fun. Am. Bor. (l. c.) evidently because Fries in the interim between Schweinitz' two publications had described another species

of *Sphaeria* as *S. conferta* Fries, Syst. Myc. **2**: 435. 1823, and for some unknown reason a few pages later (444) he also described Schweinitz' species of the same name. Fries' fungus was on leaves of *Vaccinium* and different from Schweinitz' plant.

Ellis, Proc. Phil. Acad. **1895**: 25, describes a part of one of Schweinitz' specimens which is found in the Collins' collection of Schweinitz' fungi as *Trematosphaeria confertula* (Schw.). This specimen, however, is not a part of the type specimen from Salem, North Carolina, upon which the original description was based. We find on examination of the Collins' specimen that it is labeled by Schweinitz himself "Beth.," indicating clearly that it was a part of the material gathered in Pennsylvania and mentioned in his Syn. Fun. Am. Bor. (l. c.). This specimen, though somewhat similar in superficial appearance, is an entirely different species from the type collected at Salem, as will be shown below.

The next reference to Schweinitz' species is by Starbäck, Bot. Not. **1893**: 28. 1893. He examined the specimen which Schweinitz had sent to Fries, but failed to find asci or spores, but said it was very similar in external appearance to *Sphaeria euomphala* Berk. & Curt. This specimen was probably part of the Salem material.

The next note we find on this species is by Farlow, Bibl. Index N. Am. Fungi **1**: 214. 1905. He examined a part of a specimen of Schweinitz in the Curtis Herbarium at Harvard and said that the external resemblance to *S. euomphala* is marked, but the spores did not agree with those described by either Cooke or Ellis. Two kinds of spores were found, one free, dark colored, elliptic, 8–9 × 2.8 μ, the other hyaline, acicular, 14–16 × 2.8 μ in clavate asci.

Later Fitzpatrick, Mycologia **15**: 55–57. 1923, discussed Schweinitz' species. He examined the specimen referred to by Farlow in the Curtis herbarium which was apparently a part of the Salem plant and found it to agree with *S. euomphala*. He also examined an autographed specimen of Schweinitz in the herbarium at the Philadelphia Academy, and states that it is the same as the Schweinitz specimen in the herbarium of Curtis. He found perithecia and free spores agreeing in size, shape and surface characters with those of *Sphaeria euomphala* Berk. & Curt., and also the hyphae of the subiculum were the same; but as he found no

asci he did not state positively that the two species are the same. We have examined the portion of Schweinitz' specimen found in the herbarium of Michener in the Mycological Collections of the Bureau of Plant Industry, and find not only free ascospores, but a few asci. The specimen agrees in every respect with *Sphaeria euomphala* Berk. & Curt. as shown by a comparison with the type specimen of the latter species.

We have also examined an autographed specimen of Schweinitz in Collins' herbarium referred to by Ellis (l. c.) which was collected at Bethlehem and which he called *Trematosphaeria confertula* (Schw.). This specimen, however, is really *Chaetosphaeria fusca* Fuckel, as we have determined by comparison with an authentic specimen of Fuckel's species in his Fungi Rhenani, No. *2041*.

It is evident from the studies in this case that Schweinitz' original material from Salem, N. C., upon which he based his description was rather old and contained few asci, also that evidently mixed on the same specimen, as reported by Farlow (l. c.) and as is frequently the case in such material, were pycnidia or perithecia and spores of other fungi. We have also found free spores of other species on the specimen in Michener's herbarium. The fungus which Schweinitz described from Salem, however, is so characteristic in macroscopic and microscopic appearance, and agrees so well with his description, that there is no longer any reason to doubt that it is the same as *Nitschkia euomphala* (Berk. & Curt.) Ellis & Ev., N. Am. Pyren. 246, 1892.

Due to Schweinitz' practice, as we have pointed out before, of including different gatherings of what he regarded as the same plant in the same packet, different species were frequently mixed. Thus we find in this case that the second specimen collected at Bethlehem, though much the same in macroscopic appearance, belongs to an entirely different genus. There being no longer any doubt as to the synonymy of the original species, the question arises whether Schweinitz' specific name *conferta* should replace Berkeley and Curtis' name *euomphala* on the basis of *priority*. We do not think, however, that such a change would be desirable and it might be argued, as Farlow has done, that on account of the previous

confusion in interpretation of Schweinitz' species the name *conferta* should be left as a synonym.

In this connection we may add that we use the name *Nitschkia* instead of *Tympanopsis* Starbäck, as followed by Fitzpatrick (l. c.). As he says (p. 54) *Tympanopsis* differs from *Nitschkia* chiefly in its colored spores. The spores, however, when fully mature are only slightly colored, and the separation of genera on spore color alone leads to a very artificial rather than a natural classification.

11. **Russula lilacipes** sp. nov.

Solitaria vel aliquantulus gregaria; pileo convexo usque umbilicato, 7–15 cm. diam.; superficie glabra, uda viscosa, sordida usque pallide flavidula; lamellis latis, subdistantibus, adnatis, pallide viride-flavidis vel flavidulis; stipite centrali, robusto, cylindrico, purpurascente; sapore miti; odore nullo; sporis albis, ovoideis vel subglobosis, subtiliter verrucosis, 7–7.5 × 5–6 μ; cystidiis 80 × 8–9 μ.[1]

Plants solitary or somewhat gregarious, rarely sub-caespitose; pileus broadly convex to nearly plane, soon becoming umbilicate or somewhat infundibuliform, 7–15 cm. in diameter; margin incurved when young, even; surface somewhat irregular, smooth, very viscid when wet, but with no separable pellicle, sordid or pale-yellowish or watery-cream color, somewhat suggesting in color wet specimens of *R. foetens*, paler when fresh and dry; flesh firm, compact, not changing color or only very slightly when wounded; lamellae broad, subdistant, some forked and a few short ones intermixed, adnate, arcuate toward the margin, pale greenish-yellow to pale-yellow, sometimes slightly changing to subviolaceous when wounded and becoming spotted and discolored when old; stipe central or occasionally somewhat eccentric, stout, cylindrical, smooth or somewhat pruinose, frequently irregular and somewhat pitted or ridged, solid, very firm, compact; at summit pale-yellowish pleroma-violet or bishop-purple to auricula-purple of Ridgway at the base and extending upward frequently to the middle or higher, sometimes distributed in dots and irregular spots; taste mild and pleasant; odor scarcely any, at least not unpleasant; juice none; spores white, ovoid to subglobose, delicately verrucose, 7–7.5 × 5–6 μ; cystidia somewhat clavate, acuminate, the pointed apex projecting beyond the basidia, mostly 80 × 8–9 μ. (FIG. 1.)

Type: B. O. Dodge, Radnor Heights, Arlington, Va. (Shear No. *4058*).

[1] Thanks are due to Miss Edith K. Cash for the preparation of this Latin diagnosis.

FIG. 1. *Russula lilacipes* nat. size.

Habitat: bare clay cellar bottom and bank, and road cut in woods Arlington Cemetery, Virginia, August 1, to September 17, 1922. Five other gatherings have also been made in the latter place in August and September during the years 1926 to 1938. Specimens were also collected by R. W. Davidson in Clarendon, Va., Sept. 9, 1934.

Watery drops are found on the edge of the gills when the plants are young and fresh. This is apparently water of condensation rather than exudation, but where these drops dry the gills turn purplish.

This is a remarkable species in habitat, color, and texture. The specific gravity is greater than that of any other agaric we know. A single plant weighed 8 oz. In wet weather the pileus is frequently covered with clay brought up with it as the plant emerges and adhering to the viscid surface. The violet color mostly disappears in drying.

Dr. G. S. Burlingham and Prof. H. C. Beardslee have kindly examined specimens of this plant and have confirmed the opinion that it is undescribed. Prof. Beardslee suggests possible relationship to *R. ventricosipes* Peck which is similar in color but has a thin striate margin and different texture.

12. SPHAEROSPORIUM Schw.

This genus was described by Schweinitz in his Syn. Fun. Amer. Bor. p. 303, 1832. The volume of the Proceedings of the American Philosophical Society in which this paper appeared is dated 1834, but separates were published and distributed in 1832. The original description (l. c.) is as follows:

Genus 229. *Sphaerosporium* L.V.S., Novum Genus

Sporidochiis obliteratis planiusculis, strato densissimo, pulvinatim elevato incumbente sporidiorum non simplici sed coacervato. Sporidiis majoribus pellucidis, globosis, intus includentibus massam globulosam, grumosam, opacam.

× 3036. 1. *S. lignatile*, L.v.S., in frustulis majoribus pulveris vaporariae, et in corticibus putridis Quercuum, etiam Salicum, Bethl. S. strato pulvinato sporidiorum ex ochraceo rufo-pulvinatim super sporidochium elevato. Acervis 2–3 linearibus, aggregatis, ovatis, aut longissime confluentibus. Globulus exterior sporidiorum in aqua, omnino pellucidus; interior subopacus. Sicco

tempore tota sporidia tum subangulata, ochracea et opaca deveniunt. Acervos Bactridii primo obtutu refert.

A part of Schweinitz' original collection is found in Michener's herbarium in the Mycological Collections of the Bureau of Plant Industry. With this there is another specimen of Schweinitz' labelled *S. vaporarium*, a name he apparently first considered, but changed to *lignatile* before publishing. Both specimens are on decaying wood of *Quercus* and are identical. The spores are apparently normally globose when free, but very variable in shape and size in mass, where they press against each other. The globose forms are 36–50 μ in diameter, the other forms 38–66 $\times$ 33–45 μ and the spore wall about 6 μ thick. There are no signs of sporophores in the specimens examined, and the mode of development and production of the spores is not clear. Other authentic specimens are also at Philadelphia, Kew and Harvard. The species is rather easily recognized by the small pulverulent masses of honey colored, very thick walled spores. An excellent example is to be found in Reliquiae Farlowianae, No. *667* collected by Thaxter in Connecticut in 1889. The species is evidently not rare and is known to occur from Connecticut to Louisiana. We have collected it in Maryland and Virginia. There are specimens in the Mycological Collections from North Carolina deposited by F. A. Wolf, No. *433*, and from Louisiana collected by Langlois.

Von Höhnel discussing this genus and species, Frag. Myc. No. 674, pp. 402–403, 1911, comes to the conclusion that the genus is a synonym of *Coccospora* Wallr. Fl. Crypt. Germ. **2**: 176, No. 1544. 1833. He states, however, that he had seen no authentic specimen of Wallroth's plant, and doubts whether any exists. From our comparison of Schweinitz' specimen with Wallroth's description it seems very doubtful whether the two fungi belong to the same genus, as Wallroth describes his fungus as usually oblong, cylindrical and smooth, and a beautiful orange color. When wet with water it dissolves into a mucilaginous mass, and when dry is covered with glutinate mucus. *Sphaerosporium*, so far as we have seen, always forms a low pulvinate mass of glistening, honey colored spores which are easily separated and do not dissolve into a mucilaginous mass.

Protomyces xylogenus Sacc. Michelia **1**: 14. 1879, and Fung. Ital. *fig. 104.* 1877, is also believed by von Höhnel to be, if not the same species, at least the same genus. He also states that *Bactridiopsis Ulei* P. Henn. Hedwigia **43**: 397. 1904, according to the description belongs to the same genus and is perhaps identical with Schweinitz' species. Von Höhnel's conclusions are based upon a comparison of descriptions and illustrations rather than authentic specimens, except in the case of *Protomyces xylogenus Sacc.* He compared specimens labeled *Coccospora aurantiaca* Wallr. collected by Bizzozero near Venice and a specimen so labeled by Bresadola collected by Fairman, Lyndonville, N. Y., 1904, and found them all the same. As a result of his studies he concludes that *Coccospora* should be adopted as the generic name of all the species mentioned, and *Sphaerosporium* Schw., *Protomyces* Sacc., p.p., *Bactridiopsis* P. Henn., and *Allescheriella* P. Henn. Hedw. **36**: 244. 1897 regarded as synonyms.

In our opinion, however, as just stated, *Coccospora* Wallr. according to present available information is a very doubtful synonym of *Sphaerosporium* Schw., and in any case on the basis of priority Schweinitz' name, which, as we have pointed out, was published in 1832, instead of 1834 as usually cited, is older than Wallroth's 1833, and should be adopted. *Protomyces xylogenus* Sacc. and the Bizzozero and Fairman specimens mentioned above are probably Schweinitz' species and not Wallroth's *Coccospora.*

13. SPHAERIA GLEDITSCHIAE Schw. Syn. Fung. Car. 40, No. 131, 1822

Specimens of this species collected by Schweinitz have been examined with the following results. In Schweinitz' mounted collection at Philadelphia, there are two pieces both of which show micro- and macro-pycnospores of a species of *Sphaeropsis.* There is an occasional septate spore.

The specimen of this number, *1435,* Schw. Syn. Fun. Am. Bor. in Michener's herbarium, consists of two parts and three pieces. The piece at the left is bark from a rather large branch, and bears the remains of a gummed strip of paper, such as was used by Schweinitz in mounting his early collections. This probably represents part of his Salem specimen upon which his original de-

scription (l.c.) was based. This specimen also agrees with the original description. It bears a few small closely packed groups of pycnidia which show chiefly free spores of *Sphaeropsis*.

The other two pieces at the right, probably part of the collection reported from Pennsylvania in Syn. Fun. Am. Bor. p. 206, No. *1435* as *S. Gleditsiae* (note change in spelling), are very similar in general appearance to the other specimen and show pycnidia and spores of *Sphaeropsis,* apparently identical with those from the other specimen. The pycnidia are mostly old and the spores free. Most of the spores are non-septate, but a few are septate. Minute hyaline microspores are present in separate pycnidia, and some free, 3-septate brown spores, 10–12 × 4–5 μ, belonging to some other fungus, are also found on the slides.

There are two small packets in Schweinitz' original autographed collection at the Philadelphia Academy. These are the same *Sphaeropsis* and are perhaps part of the Pennsylvania specimen. The Collins set of Schweinitz' authentic specimens of *Sphaeria* also preserved at Philadelphia does not contain this species. It is evident from an examination of this material that the fungus described by Schweinitz under this name is a *Sphaeropsis.* In Seymour's Host Index, the synonymy is given as follows:

Botryosphaeria Gleditschiae (S.) Sacc.
Cucurbitaria Gleditschiae (S.) Berk. & Curt.
Cucurbitaria recuperata Theissen.
Melogramma Gleditschiae (S.) M. A. Curtis.
Sphaeria Gleditschiae S.
Valsaria Gleditschiae (S.) Ellis & Ev.

Curtis had a specimen of Schweinitz' No. *1435,* and sent part to Berkeley, but did not make any note as to its identity.

Berkeley, in Grevillea **4**: 47. 1875, refers Curtis' North Carolina specimens Nos. *841* and *942* to "*Cucurbitaria gleditschiae* Schwein." with the note "sporidia ovate uniseptate." According to Berkeley's copy of Schweinitz's Syn. Fun. Am. Bor., he had a specimen of *Sphaeria Gleditschiae* from Schweinitz' herbarium, but whether his identification was based upon a comparison with that specimen is unknown. A little later Berkeley (l.c. p. 98) refers a specimen of Michener, No. *3943,* from Pennsylvania to

"*Melogramma Gleditschiae* Schwein." We can find no specimen labelled either *Melogramma* or *Sphaeria Gleditschiae* in Michener's herbarium with this number. There is, however, a specimen of Michener labelled "*Sphaeria Gleditschiae* Sz. ad ram. mort. *Gleditschiae*, London Grove, C. Co. (Pa.)" without number. This may be a part of the material sent to Berkeley, the number having possibly been added by Curtis who transmitted most of Michener's collections to Berkeley. Michener has added in pencil opposite this name in his catalogue of his herbarium, "*Melogramma.*" The fungus is evidently the same as that represented by Schweinitz' specimens which we have seen. A few spores of *Sphaeropsis*, some occasionally septate, are found and also what appear to be young perithecia of *Physalospora* or *Botryosphaeria*, but no asci or spores are present.

Cooke, Grevillea **13**: 109. 1884, puts Schweinitz' species in *Melogramma*, section *Valsaria*. He makes no statement as to specimens examined.

There is no evidence here that the above identifications of Berkeley and Cooke were based upon a comparison of type or authentic specimens of Schweinitz' species. In N. A. Pyren. p. 564, Ellis refers Schweinitz' species to *Valsaria*, citing Schweinitz' and Michener's localities. He evidently based his action on Berkeley and Cooke, as no spore measurements or other information is given.

Saccardo, Syll. Fung. **2**: 310. 1883, under *Cucurbitaria Gleditschiae* Ces. & D'N. cites "Cucurbitaria Gleditschiae (Schwein.) Berk. N. Am. Fun.," quoting Berkeley's statement "sporidia ovata uniseptata" and adding "an *Otthia?*" Saccardo Syll. Fun. **1**: 463. 1882, under "Minus certae" has *Botryosphaeria Gleditschiae* (Schw.) Sacc., citing as a synonym "*Melogramma Gleditschiae* (Schw.) Berk. in Grev."

Theissen, Ann. Myc. **14**: 333–335. 1916, proposes a new name, *Cucurbitaria recuperata* Theiss., for Schweinitz' fungus, citing as synonyms *Sphaeria Gleditschiae* Schw.; *Valsa Gleditschiae* (Schw.) Cooke, Grevillea **13**: 109. 1884. (In this case, Cooke used *Valsaria* as a subgeneric name under *Melogramma*); *Melogramma Gleditschiae* (Schw.) Berk. Grevillea **4**: 98. 1876; and *Botryosphaeria Gleditschiae* (Schw.) Sacc. Syll. Fung. **1**: 463.

1882. He says he examined three collections from the herbarium at Kew, two numbers in Berkeley's herbarium, *922* and Fung. Carol. Inf. *942*, the same as Berkeley mentions, besides an original specimen of Schweinitz. He says of the numbers *922* and *942*, that the last is the best developed and shows mature asci with brown muriform spores and good paraphyses, but appears identical with the other undeveloped specimens, and that all are quite different from *Botryosphaeria*. He found asci in No. *942*, short stipitate, p. sp. 130–160 × 12–15 μ, containing 8 spores, which were 6-celled, often with longitudinal septa, dark rusty-brown, 26–28 × 13 μ, constricted at the middle.[2] He says this differs in its smooth perithecia from *Cucurbitaria Gleditschiae* Ces. & D'N. which has rough warty perithecia, and also from *C. elongata* (Fries) Grév. which has a broadly effuse stroma. His discussion therefore throws little light upon the real identity of *Sphaeria Gleditschiae* Schw.

Fries, Syst. Myc. **2**: 421. 1823, says of Schweinitz' species "the groups of perithecia are sparse, 1 line long or less." This statement is evidently based upon a specimen from Schweinitz, as he cited "V.S." (dried specimens) from Carolina.

According to the records so far, we find no statement that anybody has found asci in any of Schweinitz' specimens. Cooke may possibly have found the uniseptate free spores of *Sphaeropsis* which we have found in all the specimens of Schweinitz' collection examined. It seems fairly certain therefore that the fungus which Schweinitz described was a species of *Sphaeropsis*. It is, of course, possible that there may have been a few free spores of *Valsaria* or *Cucurbitaria* on some part of his specimens, as *V. insitiva* and *C. elongata* are not uncommon on *Gleditschia* in this region.

As a result of our studies we conclude that *Sphaeria Gleditschiae* Schw. is a *Sphaeropsis* and agrees with the very common species which has been widely known as *S. malorum* Peck, and has been shown to have a great number of synonyms (cf. Stevens, Myco-

[2] This is an entirely different fungus from that which Berkeley found on the same specimen No. *942* as cited and described as having ovate uniseptate sporidia. There is evidently more than one fungus present on this specimen as is not unusual.

logia **25**: 543–546. 1933) and to have as its ascigerous stage *Physalospora obtusa* (Schw.) Cooke. Stevens also examined some of Schweinitz' collection of this species, and cites it as a synonym of *S. malorum* Peck (l.c. p. 544).

14. DRYOPHILUM Schw.

This genus was described by Schweinitz, in Syn. Fun. Am. Bor. 268, 1832, with two species as follows:

Genus 143. *Dryophilum*, L.v.S., Novum Genus, an hujus loci? Peridium pezizaemorphum, sed omnino clausum, sessile aut papilla basilari stipitatum et folio affixum. Intus similare album. Extus vestitum cortice duriusculo.

2465. 1. *D. pezizoideum*, L.v.S., in foliis vegetis Quercus Banisteri et aliorum praesertim in montibus *e.g.* Mauch Chunk Coal mine. Etiam ex Georgia communicavit Leconte.

D. sparsum, cupulis 2–3 linearibus, orbiculatis, papilla basilari affixum, disco ime depresso nigrescenti. Cortice externo fibris crassiusculis densis arcte adpressis subtus albidis tecto, margine et extus eleganter spadiceo-sericeis.

2466. 2. *D. umbonatum*, L.v.S., etiam in folio querneo communicavit Leconte ex Georgia.

D. sparsum, minus, folio subinnatum, cortice exteriori non fibroso sed glabro, ex rufo splendente spadiceo. Disco in umbonem elevato. Vix lineam excedens diametro.

Parts of Schweinitz' specimens of the two species are in Michener's herbarium. Both are insect galls. The first, *D. pezizoideum*, has been identified by Mr. L. H. Weld, specialist in gall insects, as *Neuroterus* (*Neuropterus*) *umbilicatus* Bass. He says also that the host is not *Quercus Banisteri*, as given by Schweinitz, but *Q. bicolor*. The other species, *D. umbonatum*, had galls somewhat similar in appearance, but unfortunately this specimen was lost; but from the description and figures Mr. Weld is of the opinion that the galls were those of *Neuroterus saltarius* Weld, which occurs on the same host and also on *Q. macrocarpa*. Specimens of both these numbers are to be found in Berkeley's herbarium at Kew according to check marks in his copy of Schweinitz' work cited above. The only reference to this we find in Saccardo's Sylloge Fungorum is in **18**: 771 (index) as follows: "Dryophilum Schw.= Sclerotio aff."

15. SPECIES REFERRED TO THE GENUS DOTHIDEOVALSA Speg.

Eutypa Turnerae seems to have been first described by Tassi, Bul. Lab. Ort. Bot. Siena **1899**: 139, tab. X, fig. 1, 1899. A specimen growing on a species of *Turnera* from Panama received by Mr. D. P. Limber of the Bureau of Entomology and Plant Quarantine, agrees in every particular with Tassi's description and illustration. It resembles *Eutypa*, however, only in its sulcate ostioles and allantoid spores. The stroma is typically dothideoid.

Von Höhnel, Frag. Myk. 695, 1911, reports that an examination of the type of *Epheliopsis Turnerae* P. Henn. Hedwigia **47**: 270. 1908, shows that it is identical with Tassi's fungus, but was described by Hennings as a pycnidial form and thought to be related to *Ephelis*. Hennings apparently did not see the asci. Von Höhnel says that Hennings' name should be discarded. He also suggests that Hennings' plant is probably the same as *Eutypella radulans* (Berk. & Curt.) Berl. An examination of a portion of the original material of this species in Michener's herbarium, as well as a comparison of Berlese's illustration of type material, Icon. Fung. **3**: 75, pl. 92, fig. 2. 1905, shows that this is a true *Eutypella*, quite different from the Tassi and Henning's plant. A comparison of *Bagnisiella*, as treated by Theissen and Sydow, shows that Tassi's plant does not belong in that genus either.

Further study of specimens and literature shows that Ellis and Everhart gave this plant the herbarium name, *Bagnisiella eutypoides* Ellis & Ev. in herb. There is a specimen from Ellis so labelled in the Mycological Collections of the Bureau of Plant Industry, and it is listed in Seymour's Host Index, p. 518, 1929, as occurring on *Turnera ulmifolia*.

Further study shows that Hennings' and Tassi's fungus is very similar to that described by Lewis as *Bagnisiella Diantherae* on *Dianthera* from Texas, Mycologia **4**: 70, pl. 58, 1912. A comparison of Lewis' material with that from Panama shows that both fungi are really Dothideaceous and congeneric.

Petrak, Ann. Myc. **32**: 354–356. 1934, states that *Bagnisiella Diantherae* Lewis is a good *Eutypa* and calls it *E. Diantherae* (Lewis) Petr. He says he examined part of the original specimen of Lewis. His reason for excluding it from the Dothi-

deaceae is that it has allantoid spores, which never occur (sic) in the Dothideales. He says the specimen is too old to show perithecia (asci) which have apparently " verschleimt " and the conidia described probably do not belong to this fungus but are parasitic in the perithecia. He also adds that he does not know Spegazzini's *Dothideovalsa tucumanensis,* the type of the genus, but that according to Theissen and Sydow's description it is a typical *Eutypa* which should be called *E. tucumanensis* (Speg.) Petr. and therefore *Eutypa* is a synonym of *Dothideovalsa.*

Dothideovalsa tucumanensis Speg. Anal. Mus. Nac. Buenos Aires (Ser. 3ª) **12**: 414, 1909.

We have examined the type specimen of *Dothideovalsa tucumanensis* Speg. Spegazzini has the following note on the packet: " Ad caules *Chaetithylacis Tocantini* Tucuman 15/4/1906, stroma atro, coriaceo opaco, contentu parenchymatico vix distincto loculi 150 diam." The general appearance on the stems is like *Bagnisiella Diantherae* Lewis and *Eutypa Turnerae* Tassi, but the stromata are smaller as well as the locules. Spegazzini's type agrees in all essential characters with Tassi's and Lewis' species, differing chiefly in spore size. Spegazzini's species has spores 4–6 × 1 μ; Tassi's 10–12 × 2–3 μ and Lewis' 6–9 × 1½ μ.

Lewis' species should therefore stand as *Dothideovalsa Diantherae* (Lewis) Theiss. & Sydow, and Tassi's fungus as *Dothideovalsa Turnerae* (Tassi) n. comb. *Epheliopsis* of Hennings, though a year older than *Dothideovalsa,* seems ineligible because it was described by the author as a genus of the Fungi Imperfecti. It might be argued, however, that as von Höhnel has shown, it was really an ascogenous fungus, but seems that in view of Hennings' error *Dothideovalsa* should be adopted.

Spegazzini's type also shows that it is Dothideaceous and congeneric with Lewis' *B. Diantherae.* Theissen and Sydow, Ann. Myc. **13**: 289–90. 1915, describe Spegazzini's species from this original specimen and find, as we have, that it has a typical loculate, dothideoid stroma and no paraphyses, though having sulcate ostioles and allantoid spores.

These species furnish a striking example of the fact that morphological characters usually regarded as confined to a certain

family or genus may occur in widely different families or orders. As a result of our studies we would refer all these species to *Dothideovalsa* with the following synonymy:

DOTHIDEOVALSA TUCUMANENSIS Speg. Anal. Mus. Nac. Buenos Aires (Ser. 3ª) **12**: 414. 1909.

Dothideovalsa Turnerae (Tassi) comb. nov.

Eutypa Turnerae Tassi Bul. Lab. Ort. Bot. Siena **1899**: 139. 1899.

Epheliopsis Turnerae P. Henn. Hedwigia **47**: 270. 1908.

Bagnisiella eutypoides Ellis & Ev. in herb.

DOTHIDEOVALSA DIANTHERAE (Lewis) Theiss. & Sydow, Ann. Myc. **13**: 290. 1915.

Bagnisiella Diantherae Lewis Mycologia **4**: 70. 1912.

Eutypa Diantherae (Lewis) Petrak, Ann. Myc. **32**: 354–6. 1934.

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NOTES ON THE MYCETOZOA—III

ROBERT HAGELSTEIN

Collecting activities were continued during the summer months of 1938 in the mountains of Pike and Wayne Counties, Pennsylvania, where we have operated for several seasons in the past. About a month in all was spent in several visits, at intervals, from the end of May to the end of July, and in company with either Joseph H. Rispaud or John D. Thomas. During our last excursion, after a week of heavy rain followed by three days of moist, humid weather, we found an extraordinary situation with nearly every decaying log or other suitable habitat covered with the fruiting bodies. On the day of our arrival 57 species were found, and during this and earlier trips many interesting forms were collected. Five of these are mentioned in the later notes.

The Foray of the Mycological Society of America was held in late August at the Forest Rangers School, at Duchesnay, Quebec. There, in the southern foothills of the Laurentian Mountains, surrounded by forest, lakes, and turbulent streams, we found an ideal locality. Furthermore, the occasion was a delightful and memorable one in the company of so many eminent American mycologists combined with the happy arrangements and entertainment provided by our Canadian hosts. Mr. Rispaud and I attended, and, following the Foray, spent another week in travelling and collecting across the Laurentides National Park as far as Lake St. John, about 150 miles north of the City of Quebec. The feature that stands out conspicuously in the results of the trip was the large number of rare species collected. Over 120 species and recognized varieties were found, and among them in addition to those described in the later notes are: *Comatricha aequalis* Peck, *Comatricha rubens* List., *Diachea subsessilis* Peck, *Fuligo muscorum* Alb. & Schw., *Hemitrichia abietina* (Wig.) List., *Margarita metallica* (Berk. & Br.) List., *Physarum bogoriense* Racib., *Physarum penetrale* Rex, *Physarum psittacinum* Ditm., *Physarum rubiginosum* Fries, *Trichia erecta* Rex, and

Trichia subfusca Rex. Many of these were found frequently in the limited time available, indicating that they were abundant over the large region; but in the mountains of the eastern United States we have found them only occasionally. The students in Quebec have an opportunity here not only to increase the knowledge about the geographical distribution of the Mycetozoa in North America, but to study the reasons for the abundance, whether due to timber or soil, or, if in some of the unglaciated areas of Quebec and Ontario the Mycetozoa have survived since pre-glacial time, and subsequently spread southward across the valley of the St. Lawrence River.

I am taking this opportunity to offer some suggestions to those who are conducting culture experiments in the germination of spores, and the raising of plasmodia and fruiting bodies of the Mycetozoa. The usual practice is to gather some fruitings in the field, sow the spores on various artificial media such as agar, gelatine, paper, etc., and feed the plasmodia with various powdered cereals; or sclerotium is used in place of the spores. This is usually done in small, restricted vessels. Such methods may be useful for certain purposes, but in the main are of little value beyond indicating the adaptability of the species to the forced habitat and food, and the possible changes in the fruiting bodies that may result. Unsatisfactory consequences must be expected when unnatural procedure is followed. There is no universal habitat nor a universal food for the Mycetozoa—no more than there is for any other group of living organisms—although the food supply in nature is closely related to the habitat. The student who wants results must provide a base for the plasmodium which will conform to what it has in its natural haunts.

Many species thrive on wood of various kinds; others on different leaves; others again require particular wood, leaves, or other material. This indicates that the character of the bacterial content is important in the development of certain species, as well as the absence of enemies, the acidity or alkalinity of the habitat, temperature, and perhaps other factors. The student should make a preliminary study of the conditions existing in nature, selecting a large, fertile, decaying log, and examining it at short intervals in different weather; noting its relation to the surround-

ings; the kind of wood it may be; the size in relation to the forms that may appear; the different species that are in harmony; the size of the developments of the fruiting bodies; and the intervals between repetitions of the same species. Specimens of each fruiting should be taken immediately after perfect maturity before natural germination of the spores has commenced, and before contamination with other spores. When ready to start experiments in the laboratory, a large portion of the original log should be taken, cultures made of the inherent bacteria and perhaps also the Protozoa, the wood broken into small pieces and thoroughly sterilized. This sterilized wood, with some attention paid to the former acidity or alkalinity, and impregnated again with food from the previously made cultures as may be found necessary, will form a natural habitat for the species originally inhabiting the log. Sufficient base should be used, about a half cubic foot for a plasmodium forming sporangial developments covering from six to eight square inches. The spores should not be scattered, but placed in masses so that the swarm-cells are in close proximity when germinated, thereby facilitating fusion to form the plasmodium. Experiments with clean washed sclerotium taken from the same log during the cold months, may also be conducted. Modifications should be worked out to fit particular conditions.

The mature fruiting bodies of the Mycetozoa are wet from the excess liquid discharged by the plasmodium during the process of fructification. The spores commence to germinate in this liquid immediately, and will continue to do so if moist conditions persist. Much of the material gathered in the field has spores that are partially germinated. The viability of the spores decreases with age, and rapidly in some species. Such spores take a longer time to germinate. This variation in the spores explains the lack of uniformity in the time of germination in different gatherings of the same species so often encountered. With satisfactory conditions, the plasmodium will vegetate for a definite period and until it reaches an appropriate size. The time and size varies with different species. If it should grow too large it may divide into two or more plasmodia and function as such. The fruiting bodies must have moist conditions while forming, and if these are interrupted by extreme drying, the development will be abortive.

Some species require but a few hours to reach complete maturity; others need several days, up to a week. The usual time is one or two days. With good, moist conditions, the cycle from the beginning of germination, through the vegetative stage of the plasmodium to the matured fruiting bodies, is about one month for most of the common species. With others it is much longer, up to five months. If dry weather intervenes during the period of the cycle, the spores will not germinate rapidly, or, the plasmodium through lessening of the food supply will draw itself deeper into the habitat, and become smaller and inactive. This will break the sequence of the cycles, but they are renewed each year as the first fruitings in the spring are usually from revived sclerotium. Plasmodium in the form of sclerotium may remain dormant in logs or other habitats for a long time, in fact for years, with no opportunity to revive and vegetate long enough to produce sporangia. Suddenly, with changed circumstances, fruiting bodies and sometimes those of rare species will appear on habitats which have been examined frequently and regarded as sterile. These conclusions are based on many field observations of the habits of the plasmodium extending over a long period of years. Taken in conjunction with moisture conditions in an area where the Mycetozoa are known to be, it is possible to estimate with a fair degree of accuracy when the fruiting bodies may be expected in abundance. Moisture is not necessarily in the form of general rains. It will be in swamps, in the mists of enclosed lakes, in the spray of rushing water through small ravines or gorges, the dew, or a long condition of general humidity. We take all these into consideration when arranging the time for our excursions so that they are usually successful from a collecting point of view.

In the following notes the year 1938 is meant when no other year is given, and the collections were made by Mr. Rispaud and I, in company, unless otherwise indicated.

ARCYRIA FERRUGINEA Sauter. A fine development of the small phase discussed in my first series of Notes (Mycologia **29**: 393–396. 1937) was found by Mr. Thomas in Pike County, Pennsylvania, in July. The fruiting appeared as several colonies about six feet from the ground on a dead, standing tree. In some colonies the sporangia are shortly cylindric; in others, ovoid or

subglobose. The spores are slightly smaller than in the earlier collections, many of them a trifle under 10 μ. It was observed again that the sporangia require several days to arrive at complete maturity. N. Y. B. G. No. *4751.*

BADHAMIA OVISPORA Racib. The species has come to me again from Canada, this time on manure in a greenhouse at Byron, Ontario, and collected by Mr. Eli Davis in April. N. Y. B. G. No. *8697.*

CALONEMA AUREUM Morg. Collected on cow dung near Gainesville, Florida, in August, by Drs. William A. Murrill and Erdman West. The capillitium is sparingly branched and the spores are smaller than usual, 11–12 μ diam. The species is not common and in habit and appearance resembles *Oligonema nitens* (Lib.) Rost., but distinguished in the field by the deeper, golden-yellow color. N. Y. B. G. No. *8883.*

COMATRICHA TENERRIMA (Curt.) G. List. Two collections made in the Laurentian Mountains of Quebec, in August, consist of ovoid sporangia on long stalks. Aside from the long stalks, there is little to distinguish the form from *Comatricha pulchella* (Bab.) Rost. The capillitium and spores are a trifle paler, and the warts on the spores are not so prominent as in the latter species. N. Y. B. G. Nos. *4556, 4590.*

CRATERIUM LEUCOCEPHALUM (Pers.) Ditm. A collection regarded as var. *rufum* G. List. was made at Willsboro, Essex County, New York, in September. The sporangia are sessile or shortly stalked and red or brownish-red all over including the well defined lids. A prominent pseudo-columella, in many instances, protrudes slightly through the lids, and the lime in this, as well as in the lime-knots, is also red occasionally. The sporangia are well developed, but the presence of plasmodiocarps indicates to me that the variety may be only an abnormal form or sport such as we find often in other species. The crystalline discs are not present in the walls or lime-knots, but this is not a constant feature as I have found in other phases of the species where they may be present at times. N. Y. B. G. No. *4746.*

CRIBRARIA ELEGANS Berk. & Curt. The form is not often reported from east of the Mississippi. It was found by Dr. William

D. Gray, in Decatur County, Indiana, in August. N. Y. B. G. No. *8705*.

CRIBRARIA LAXA Hagelstein. Two small fruitings were found at the type locality on Long Island, New York, in July. They are on leaves and identical with the earlier collections. The species has maintained its characters through seven collections made over a period of twelve years. N. Y. B. G. Nos. *1973, 1974*.

CRIBRARIA RUFA (Roth) Rost. Sent here and collected by Mr. Eli Davis at Byron, Ontario, in September 1937. N. Y. B. G. No. *8485*.

DIACHEA THOMASII Rex. Two large and finely matured colonies of this beautiful species were found in Pike County, Pennsylvania, in July, by Mr. John D. Thomas, one of my associates. They developed two days apart from plasmodia which were yellow shortly after emergence, and within a few feet of each other. Two full days were required to attain full maturity. The developments are typical with iridescent, coppery sporangia, partly on orange stalks as long as the diameter of the sporangia, or sessile and crowded. The spores appear olive-colored, are warted, and have the dark patches of smaller warts which are characteristic of the species. The spores measure 10–12 μ diam. The few records of the species are confined to North Carolina and Tennessee, more than five hundred miles from the present locality. It should be found again in the intervening territory. N. Y. B. G. No. *4745*.

DIDERMA OCHRACEUM Hoffm. A specimen collected in the northern part of the Laurentian Mountains in Quebec, in August, and on the tips of moss, has wrinkled sporangia of an ochraceous color, 0.4–0.7 mm. diam. The outer wall is pitted with numerous small, irregular pits or depressions of a dark color which give a mottled appearance to the sporangia by reflected light. With transmitted light they appear to be thickenings in the closely attached yellow, membranous inner wall, pressed into the pits of the outer one, and orange-red in color. There are no lime granules in the walls nor a layer of lime granules between them. There is no columella. The profuse capillitium consists of slender, purplish-brown threads, pale at the tips, but not at the bases. The spores are lilac-brown, spinulose, 9–10 μ diam.

There are features about this form which if maintained in fur-

ther collections may be regarded as sufficient to separate it from *D. ochraceum*. For the present it is retained there. N. Y. B. G. No. *4593*.

DIDERMA SAUTERI (Rost.) Macbr. This rarely collected species was found in the northern part of the Laurentian Mountains, Quebec, in August. The pale ochraceous, sessile sporangia encircle the tips of moss. The outer wall is dense with lime granules and separates readily from the membranous inner one, so that the sporangia appear wrinkled or shrunken. The columella is not defined, sometimes a mere thickening of the base, reddish or brownish, and giving attachment to the threads of the capillitium. The latter are scanty, colorless, straight and forking at the tips, with little branching. Although the development is normal and finely matured, the spores vary from 12–16 μ diam. They are moderately dark purplish-brown and spinose. N. Y. B. G. No. *4591*.

DIDYMIUM DIFFORME (Pers.) Duby. A collection of var. *comatum* List. was found on leaves by Dr. C. L. Shear during the Foray of the Mycological Society at Duchesnay, Quebec, in August. The profuse capillitium consists of slender, straight, purplish-brown threads, of equal breadth throughout, and the spores measure 9–10 μ diam., smaller and paler than those of the typical form. N. Y. B. G. No. *4509*.

DIDYMIUM OCHROIDEUM G. List. We have found this species heretofore only on Long Island, New York. It was found again on the stalks of skunk cabbage and moss at Sawmill Pond, Pike County, Pennsylvania, in June. There were several fruitings, probably, but as the species forms very small developments, and they are difficult to keep apart, they were joined as one specimen. The Pennsylvania material is typical. N. Y. B. G. No. *4754*.

LEPIDODERMA TIGRINUM (Schrad.) Rost. Not often found in the East. A collection of typical sporangia was made in Pike County, Pennsylvania, in June, and would have made a fine specimen if we had seen it earlier. As it was, we were late and the sporangia are badly weathered. In order to get good material, one must be on the ground shortly after the fruiting bodies appear. A week's time is about the limit. N. Y. B. G. No. *4755*.

LICEA TENERA Jahn. Two specimens developed in moist chambers have come here, one from Kansas, and the other from To-

ronto, the last on dung from Brazil. Both are very dark in color due to the presence of considerable refuse matter in the walls. The species is described as having little or no refuse matter but this is not always so. In that respect it is similar to *Licea flexuosa* Pers., although distinct in forming small, subglobose sporangia instead of the larger plasmodiocarps of the latter species. One of the specimens was referred to Prof. Jahn who confirmed the determination. N. Y. B. G. Nos. *8326, 8517.*

LYCOGALA CONICUM Pers. The records for this species in North America are limited, so it is reported here that fine typical developments were found by Dr. William D. Gray, in Decatur County, Indiana, in August, and by Dr. Erdman West at Gainesville, Florida, in October. N. Y. B. G. Nos. *8719, 8882.*

PERICHAENA CHRYSOSPERMA (Currey) List. On leaves, at Duchesnay, Quebec, in August, were found the small stalked forms formerly regarded by Lister as *Perichaena vermicularis* (Schw.) Rost. var. *pedata,* but transferred to the present species in the last edition of the Monograph. Each leaf carries one or two minute, brown, sporangia 0.15 mm. diam., on dark stalks of about the same height. The capillitium is fairly abundant with little branching, and is minutely spinulose. The spores measure 8.5–9.5 μ diam. N. Y. B. G. No. *4522.*

PHYSARUM ALBESCENS Macbr. This unique form was collected by Dr. Erdman West at Gainesville, Florida, in November. It resembles *Leocarpus fragilis* (Dicks.) Rost., and differs therefrom mainly in the character of the outside wall which in the latter species is cartilaginous and shining without innate lime granules. The sporangia of the Florida specimen are sessile, with rough, outer walls composed of densely aggregated, yellow lime granules; the walls breaking away and separating from the membranous inner ones, which have white lime granules. The capillitium is typical with large, irregular, pale yellow lime-knots. The spores are purplish-brown, not dark, spinulose, and measure 10 μ. N. Y. B. G. No. *8885.*

PHYSARUM CITRINELLUM Peck. This is one of the species that we have never observed in the field until this year, and it seems that all the collections from the eastern United States were made many years ago. It was abundant in the Laurentian Mountains of

Quebec in August, and six fruitings were found there. The sporangia are yellow, varying occasionally from white to orange, and on orange-red stalks. The habitat, as we found it, was among moss growing on the sides of wet rocks. There is no difficulty in recognizing the form with a hand lens. N. Y. B. G. Nos. *4441, 4446, 4486, 4493, 4565, 4706.*

PHYSARUM CITRINUM Schum. A species akin to *Physarum globuliferum* (Bull.) Pers., and also to *Physarum murinum* List., but with bright, yellow lime in the wall, stalk, and lime-knots. It has been rarely reported from North America. A fine collection was made in Pike County, Pennsylvania, in June. N. Y. B. G. No. *4747.*

PHYSARUM CONGLOMERATUM Rost. A poorly developed specimen collected in Quebec, in August, is regarded as closer to this species than to *Physarum contextum* Pers. because of the very pale and faintly marked spores. A few of these are 10 μ diam., but the great majority measure 11–13 μ. It may be intermediate, or the large spore size may be due to imperfect development. Further collections are necessary to show clearly that the species is present in Quebec. N. Y. B. G. No. *4502.*

PHYSARUM CONTEXTUM Pers. Var. *Mortoni* G. List. is merely a phase of this species in which the sporangia are more loosely clustered or free with a tendency to form short, imperfect stalks. Macbride regarded it as specifically distinct. Emphasis placed upon minor differences in other characters magnifies their importance, but they are found constantly in otherwise typical developments, when the species is found in abundance, and sometimes in the same fruiting. The form should not be regarded as a variety, much less as a species, and should be abandoned as superfluous and tending to cause confusion by its presence in the literature. Loosely clustered or free sporangia, with or without stalks, are often present in large developments of *P. contextum*, and occasionally an entire small colony may consist thereof. Two such selections have been made from the extensive Quebec material. N. Y. B. G. Nos. *4477, 4708.*

PHYSARUM LISTERI Macbr. Described from Virginia in my Notes of last year. The only earlier North American record is from Colorado. The species appeared abundantly on leaves and

other ground matter under low vegetation on sand dunes along the shore of Lake St. John, Quebec, about a mile north of the village of St. Gedeon. Five fruitings were found in a few hours over a limited part of the area, but it was not collected elsewhere. The sporangia are about the same as those of the Virginia specimen but with practically no lime in the capillitium, reminding one of the near relation to the genus *Diderma*. N. Y. B. G. Nos. *4545, 4546, 4547, 4720, 4721.*

PHYSARUM ROSEUM Berk. & Br. This rare species has come to me from Dr. Erdman West who has collected so many interesting forms in Florida. It was found at Gainesville in July 1935. In appearance it is similar to the common *Physarum pulcherrimum* Berk & Rav. but more reddish in color. The stalks are translucent and free from lime, and the lime-knots are large, angular and branching. In *P. pulcherrimum* the stalks are brittle, containing lime, and the lime-knots are small and rounded. These are the important differences between the species. N. Y. B. G. No. *8881.*

PHYSARUM SULPHUREUM Alb. & Schw. During our visit to the Laurentian Mountains in Quebec, we made twelve collections of stalked and sessile sporangia of the species formerly regarded as *Physarum variabile* Rex. They all show the variations in shape of the sporangia, differences in shade of the yellow color, and irregularity of the lime-knots and stalks, that are usually found in developments of the form. The spores are purplish-brown, spinulose, and measure 9.5–10.5 μ diam. Also, we made ten gatherings of sessile sporangia and plasmodiocarps, formerly known as var. *sessile* of *P. variabile*. In all characters except the manner of sporangial formation, these fruitings are identical, and the sessile sporangia in one series cannot be distinguished from similar sporangia in the other one.

Miss Lister, in the last edition of the British Monograph, regarded *P. variabile* as synonymous with *P. sulphureum*, and, at the same time, placed the var. *sessile* with *Physarum sessile* Brandza. The large amount of material from Quebec indicates clearly that *P. variabile* and *P. sulphureum* are the same species and all the collections are regarded here by the latter name which has priority. Also, it is certain that the plasmodiocarps and ses-

sile sporangia belong to the same species so that these are regarded as var. *sessile* of *P. sulphureum*.

The plasmodiocarps do not belong with *P. sessile* Brandza. That species as described and shown by specimens distributed by Brandza has white or grayish-white sporangia and plasmodiocarps with pale, almost smooth spores, which measure 7–8 μ diam. The spores of *P. sessile* are like those of *Physarum cinereum* (Batsch.) Pers., and it seems to be a robust phase of the latter. Brandza also proposed the name of *Physarum aureum* for yellow, sessile sporangia and plasmodiocarps with yellow lime-knots, and spores 10–12 μ diam. I have not seen an authentic specimen, nor have I seen anything from North America that can be definitely linked with the description. The description and figures, in some respects, are much like those of *Physarum Serpula* Morg. Brandza's name cannot be retained under the Rules of Nomenclature as *Physarum aureum* was applied by Persoon in 1794 to a form now regarded as synonymous with *Physarum viride* (Bull.) Pers.

P. sulphureum var. *sessile* has a striking resemblance to *P. Serpula*, particularly if small, selected specimens are compared. *P. sulphureum* forms single developments, varying in color and in the shape of the units of the fructification. *P. Serpula* forms many, small developments within a limited area, uniform in color and general shape, and the sessile sporangia are globose or subglobose, and never ovoid, piriform, or showing a tendency to a stalk. The plasmodiocarps of *P. Serpula* are narrower and longer, more sinuous, branched, net-like, or ring-shaped. The lime-knots are smaller and denser, with very short connecting threads which often present a *Badhamia*-like appearance. The spores are larger than in *P. sulphureum*, 10–12 μ diam., and in all specimens I have seen are paler on one side. Some of the Quebec collections of *P. sulphureum* also show a pale area on the spores, but this is not uniform throughout the collections.

P. sulphureum var. *sessile* is represented, under different names, by fig. *b*, on plate 22, in the second and third editions of the Lister Monograph. Figures *a*, on the same plate, are not the same form. I have here three specimens of the latter, one of which is probably from the same material figured by Lister. Their position is not clear. Further collections and field observations of the habit and

associations are required as they may be plasmodiocarps of another known species. Many specimens in the Herbarium of the New York Botanical Garden.

PHYSARUM TESTACEUM Sturgis. Fine and typical developments of this species were found by Mr. Eli Davis and Mr. W. D. Sutton at Komoko, Ontario, in October and November. The outer sporangium-wall is delicate, pliable, wrinkled or rugose, and with dense deposits of lime granules; the inner one, membranous, often widely separated from the outer one, but again firmly attached so that the two cannot be distinguished. The sporangia are sessile and measure 0.8–1 mm. across. The lime-knots are angular and branching. The spores are purplish-brown, spinulose, distinctly darker and more spinulose on one side, and measure 8.5–9.5 μ diam. The November collection shows the hollow columella mentioned by Lister.

In the past this form has been confused with *Physarum bitectum* List. and *Physarum didermoides* (Ach.) Rost. mainly on the relations of all three to a species described by Rostafinski as *Physarum Diderma*. The early literature is thereby somewhat muddled, but in the last edition of the British Monograph the three species are set out distinctly. That *P. testaceum* is the same as *P. Diderma* Rost. is extremely doubtful. The Polish text of Rostafinski has been translated with differing interpretations; the type specimen is not available; and, besides, *P. testaceum* seems to occur only in North America and the first recorded collections—unless Rostafinski had it—were not made until many years after the Polish Monograph was published. It is better to accept the name given by Sturgis. N. Y. B. G. Nos. *8789, 8828.*

STEMONITIS UVIFERA Macbr. The principal character of this form is that the spores are clustered in groups; otherwise it is similar to *Stemonitis splendens* Rost. In the collection of Mycetozoa acquired in 1938 by the New York Botanical Garden from Dr. William C. Sturgis, there were found two specimens obtained by Dr. Sturgis from the late A. P. Morgan of Ohio. One was collected in June 1895, and the other in August 1896, many years before the form was found again and proposed as a species. There is nothing to indicate where the collections were made. Nearly all the spores in the earlier collection are free and measure 7–9 μ

diam. There are a few small, loose clusters. In the later collection, all the spores are firmly clustered in small groups, and the spores measure 8.5–11 μ diam. Otherwise there is nothing important enough to distinguish the sporangia from those of *S. splendens.*

The form has not been found often and seems to vary in the degree of clustering and the spore size. It is probably no more than a sport or abnormal phase of *S. splendens.* N. Y. B. G. Nos. *10471, 10520.*

TRICHAMPHORA PEZIZOIDEA Jungh. A species remarkable for the extreme variations in the capillitium, and in the size, color, and marking of the spores. The constant features are the broad, saucer-shaped sporangia on translucent, reddish-brown stalks. A fine collection was made by Dr. Erdman West at Gainesville, Florida, in July. The slender threads of the capillitium vary in different sporangia, sometimes filled with lime throughout like a *Badhamia,* or with less lime like a *Physarum.* The spores are dark purplish-brown, strongly spinose with long spines, and measure about 12 μ diam. N. Y. B. G. No. *8884.*

THE NEW YORK BOTANICAL GARDEN

PHOTOGRAPHS AND DESCRIPTIONS OF CUP-FUNGI—XXXII. PODOPHACIDIUM

FRED J. SEAVER

(WITH 1 FIGURE)

In 1868 Niessl founded the above named monotypic genus. Because of the peculiar method of dehiscence of the apothecium Saccardo placed the type species in the genus *Urnula,* calling it *Urnula terrestris.*

In 1907 Boudier established the genus *Melachroia* based on *Peziza xanthomela* Pers. At the same time he transferred to his new genus *Podophacidium terrestre* Niessl. Why he did not use the generic name proposed by Niessl instead of proposing a new one is not apparent. Since that time various authors have claimed that *Podophacidium terrestre* was identical with *Peziza xanthomela* Pers. For the most part, however, the two species have been kept distinct and placed in different genera.

During the Mycological Foray at Quebec in the summer of 1938, the writer encountered for the first time in the field a fungus which he identified as *Podophacidium terrestre.* This fungus, however, agreed in every detail with the description and illustration of *Melachroia xanthomela* Boudier. Examination of our herbarium disclosed that the species had been seldom collected in America, and never under the name assigned to it by Boudier.

The earliest collection contained in our herbarium was one obtained by B. O. Dodge in Wisconsin in 1909. This was identified by Dr. H. Rehm of Germany as *Urnula terrestris,* while our specimen collected in Quebec was readily referred to *Melachroia xanthomela* Boudier. A fragment of the material collected at Wisconsin was revived and found to agree in every detail with the recent collections in Quebec. This field observation has convinced the writer that the two species *Podophacidium terrestre* Niessl and *Melachroia xanthomela* Boudier are one and the same thing. If this fungus is to be maintained in a sepaprate genus

FIG. 1. *Podophacidium xanthomelum* (Pers.).

the name *Podophacidium,* proposed by Niessl in 1868, would have priority over *Melachroia* established by Boudier in 1907.

Up to this time there were just four specimens of this species in the herbarium of The New York Botanical Garden from North America: the one already referred to, collected by B. O. Dodge in Algoma, Wisconsin, in 1909; one collected by H. S. Jackson in Toronto, Canada, in 1932, and determined by the writer; one collected in January 1935 by Raymond H. Torrey, and identified by Miss Ellys Butler, and a fourth collected in Quebec in 1935 by Dr. F. L. Drayton, and communicated by Lawrence White to the writer for determination. This species is therefore sufficiently rare to deserve honorable mention.

Two collections were made in Duchesnay, Quebec, during the summer of 1938, one by H. H. Whetzel and the other by the writer. The diagnosis is as follows:

PODOPHACIDIUM Niessl in Rab. Fungi Eu. *1153.* 1868.
Melachroia Boud. Hist. Class. Discom. 96. 1907.

Apothecia contracted at the base, substipitate, obconic to turbinate, opening with a laciniate aperture; hymenium freely exposed at maturity and bright colored; asci clavate, inoperculate, 8-spored; spores simple, hyaline.

TYPE SPECIES, *Podophacidium terrestre* Niessl.

Podophacidium xanthomelum (Pers.) Kavina, Crypt. Czech. Exsicc. *217.* 1936.
Peziza zanthomela Pers. Syn. Fung. 665. 1801.
Peziza xanthomela Pers. Myc. Eu. **1**: *296.* 1822.
Podophacidium terrestre Niessl in Rab. Fungi Eu. *1153.* 1868.
Aleuria xanthomela Gill. Fr. Champ. Discom. 207. 1886.
Humaria xanthomela Sacc. Syll. Fung. **8**: 128. 1889.
Urnula terrestris Sacc. Syll. Fung. **8**: 550. 1889.
Melachroia xanthomela Boud. Hist. Class. Discom. Eu. 97. 1907.
Melachroia terrestris Boud. Hist. Class. Discom. Eu. 97. 1907.

Apothecia thickly gregarious, occasionally a few closely crowded, the hymenium bright yellow with a slightly olive tint, surrounded with a dark brownish or almost black laciniate border, the outside

of the apothecium dark brownish or nearly black reaching a diameter of 3–4 mm.; asci clavate reaching a length of 90–125 μ and a diameter of 7–9 μ; spores ellipsoid, the ends slightly attenuated, usually with two oil drops 5–6 $\times$ 10–17 μ; paraphyses very slender, branched.

On soil in coniferous woods.

TYPE LOCALITY: Europe.

DISTRIBUTION: Washington to northern New York, Toronto and Quebec; also in Europe.

ILLUSTRATIONS: Rab. Fungi Eu. *1153;* Niessl Beit. *pl. 7, f. 50;* Boud. Ic. Myc. *pl. 449* (as *Melachroia xanthomela* (Pers.) Boud.); Cooke, Mycogr. *pl. 11, f. 41* (as *Peziza xanthomela* Pers.), Papers Mich. Acad. Sci. **22**: *pl. 15, f. 2.*

THE NEW YORK BOTANICAL GARDEN

KARSTEN'S TYPE SPECIMENS OF HYSTERIACEAE ON CONIFERS

M. L. LOHMAN

(WITH 4 FIGURES)

Certain specimens collected by Karsten have been examined with attention to associated conidial stages as well as features which he described.[1] One, *Hysterium sphaeriodes* Karst., a species which has been collected but once in the United States (White Mountains; on wood of *Betula*), is discussed in a previous paper (**15**). Of those with a coniferous substratum several are of particular interest for their occurrence in North America or for their conidial status (*Gloniella ambigua,* now referred to *Hysterium; Lophium laeviusculum* and *L. mytilinum,* both of the genus *Mytilidion*).

Karsten treats the Hysteriaceae in three of his general works (**6, 7, 9**), admirably combining in his descriptions, as Hintikka states (**5**), detail of diagnostic features with clarity and brevity in exposition. The descriptions of new species in the first are republished by Rabenhorst (**16**). In general his species for Finland and Lapland have not been reported elsewhere in Europe, or the names as synonyms have received varied or inconsistent treatment. Only recently has American material been so identified, and then usually with some question. As to *Mytilidion Karstenii* Sacc. (*Lophium mytilinum*), which is not uncommon on pine wood and bark in New England, it is interesting to note that in the early American compilations Cooke (**2**) reports no collections suggestive of the species, but Ellis (**3**) possibly refers some to *M. fusisporum* (Cooke) Sacc.

GLONIELLA AMBIGUA Karst. (FIGS. 1, 2*A*)

A specimen marked "Mustiala in ligno vetusto pineo. 2 Nov. 1890," with descriptive notes and other data as published by

[1] For the opportunity to study this material the writer is very grateful to Professor Harald Lindberg, of the University of Helsingfors.

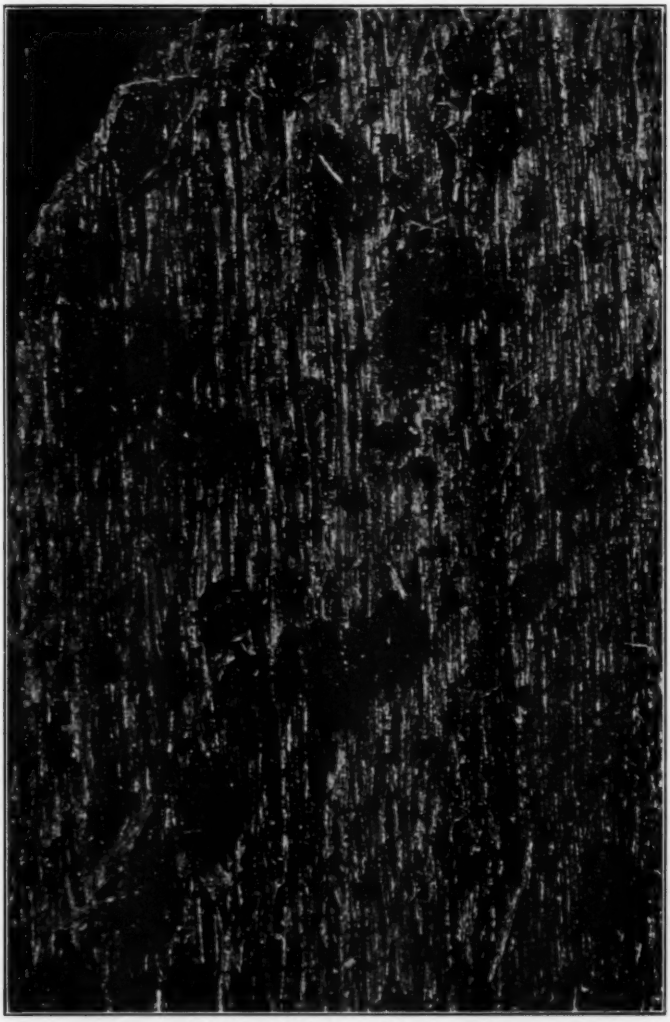

FIG. 1. *Gloniella ambigua* Karst., showing the *Sporidesmium* stage; × 30 ("Mustiala in ligno . . . pineo . . . 1890").

Karsten (**10**), is the type for *Gloniella ambigua*. The wood is coniferous, and hysterothecia and conidia (*Sporidesmium*) are abundant. The hysterothecial walls are only subcarbonaceous; mature spores are brown rather than hyaline, and considerably shorter than described. The conidial stage is not identifiable with any form species recorded for coniferous wood in northern Europe.

Mature hysterothecia are scattered, up to 0.5 mm. long, nearly superficial, with prominent longitudinal fissure and complete basal wall. However, many are immature and only erumpent, with the sunken ends acute. Asci measure 70–80 × 10–12; ascospores 21–24 (26) × 6.[2] The spores are biseriate-overlapping to subtriseriate, constricted at the septa and yellowish to clear brown when finally 3-septate. Conidia, which blacken the wood, occur singly or closely aggregated in definite, linear, minute sori, and measure 15–22 in diameter, when irregularly globose, or 25–30 × 12–15, when oblong. Pycnidia are lacking. None of the fructifications examined had ascospores as long as Karsten noted, *i.e.*, 27–34.

The species is an interesting one for its apparent relationship with *Hysterium hyalinum* C. & P. The two have similar conidial stages, and broadly fusoid ascospores which darken slowly (**14**). It appears to be distinct when compared with reasonably well known species of *Hysterium* in Europe and North America. The name, **Hysterium Karstenii** nom. nov., is proposed for the species, since *Hysterium ambiguum* is preoccupied.

HYSTERIUM CONIGENUM Karst. and H. STROBILARIUM Karst. (FIG. 2*B*)

The fungus on cone scales of *Picea* to which Karsten (**8**) formally applied first the name *Hysterium strobilarium*, and later (**9**), *Glonium strobilarium*, might well be retained under *Glonium*.

Two specimens have been examined—of different collection date, but identical: (1) Karsten's Fung. Fenn. *467* under the name *Hysterium conigenum* Moug. ("Merimasku, April"), in the Farlow Herbarium, and a portion of the same from the Karsten Herbarium; (2) Specimen in the Karsten Herbarium labelled "*Hysterium conigenum* Karst. (non Moug. et Nestl.) . . . *Hysterium*

[2] All measurements of microscopic features are given in μ.

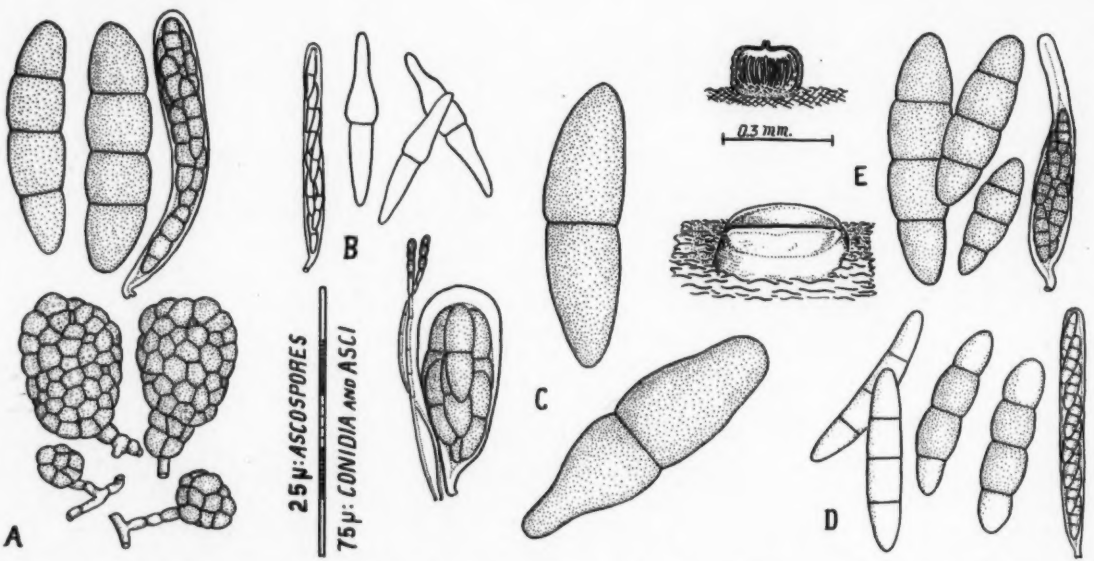

FIG. 2. *A, Gloniella ambigua* Karst.; *B, Glonium strobilarium* Karst. (*Hysterium conigenum* Karst. "Mustiala . . . 1867"); *C, Hysterium conjungens* Karst. Fung. Fenn. No. *858; D, Hysterium curtum* Karst. ("Soukelo ad arbor. frond . . . 1861"); *E. Mytilidion decipiens* (Karst.) Sacc. ("*Lophium decipiens* Karst. . . . Tammela . . . 1869").

strobilarium Karst. . . . Mustiala, in strobilis abietis, 5 Junii 1867, leg. P. A. Karsten." Karsten cites both (**6**) under *Hysterographium conigenum* (Moug. et Nestl.). The specimens agree with his descriptions, particularly the second and more complete one (**7**, p. 235), wherein he cites neither of them but instead, Mougeot and Nestler's Stirp. Crypt. 75, which authors refer to *Hypoderma*.

The hysterothecia are closely aggregated, black, punctiform but elliptic-oblong, erumpent by elongate crests, 0.15 to 0.2 mm. in length, subcarbonaceous and parenchymatic. Asci are 55–60 × 6, straight cylindric and paraphysate; ascospores 14–16 × 2.5–3, obliquely uniseriate, fusoid with the upper cell swollen at the septum, slightly curved, greenish-hyaline and noticeably constricted.

Considering *Hysterium strobilarium* Karst. a synonym of *Dichaena strobilina* Fries is no less confusing because of the frequently recorded uncertainty of the latter.

HYSTERIUM CONJUNGENS Karst. AND HYSTEROGRAPHIUM CONJUNGENS Karst. (FIG 2C)

Karsten (**7, 9**) refers materials described (**6**) as *Hysterographium conjungens* to *Glonium graphicum* (Fries) Duby. However, these specimens do not conform to the usual conception of *G. graphicum* in Europe.

The specimen here considered the type is labelled "Mla. ad cortic. Pini sylv. P. A. Karsten. 13 Apr. 1868." His descriptions—in 1871, and on distribution No. 858—are based upon the notes on this packet. But the printed label on his distribution reads "Mustiala . . . Maj."

The four fructifications in the type specimen are superficial, black, widely scattered and without a subiculum, up to 1 mm. in length, elongate but with the hymenium exposed. The exciple is leathery rather than carbonaceous. In view of Karsten's data on the packet and scarcity of material preparations were made instead from his No. *858* in the Farlow Herbarium in which there are a number of scattered apothecia similar to those described above. Asci are pyriform, 50–60 × 18–20, with numerous septate, simple (or branched?) paraphyses with swollen, dark tips. Karsten (**6**)

describes the asci as being oblong, giving no measurements, but on the packet records them as 60–70 × 21–25. In shape and size, thick wall, and conglobate arrangement of spores, they differ from *G. graphicum* (Fries) Duby as the species is commonly recognized. The ascospores are elliptic-oblong to broadly fusoid, 2-celled, clear brown when mature and measure 22–28 × 8–10. Since Karsten recorded them as 28–38 × 9–12, considerable variation in length is indicated.

This fungus may be a species of the Patellariaceae.

HYSTERIUM CURTUM Karst. (FIG. 2D)

Karsten (**9**), in following Saccardo, considers *Hysterium curtum* (**7**) under *Gloniella*. Although he records the species for several localities on wood of conifers and hardwoods, it is seldom reported in European literature and its exact status remains questionable.

A specimen labelled " Soukelo ad arbor. frond. Karsten 21 Juni 1861 " appears to be the type. Ascospores are sketched as being 3-septate, unconstricted, curved and hyaline, with pointed ends—apparently immature. They are noted as " 13–16 × 2½–3½." The several fructifications examined yielded in each case empty asci together with 8-spored immature asci, 60–80 × 6, with greenish-hyaline, elliptic-oblong, 1- to 3-septate spores arranged obliquely in a single row. Free spores on the wood and about the fructifications were found in abundance. They are fusoid-oblong, 12–16 × 3–4, 3-septate, deeply constricted, with central cells dark-brown and end cells yellowish.

With the fructifications nearly spherical, up to 0.4 mm. long, the species may be a *Lophiostoma*.[3]

LOPHIUM DECIPIENS Karst. (FIGS. 2E, 4A)

Karsten's specimen (labelled " Runsala, enbark, 2 Juni, 1861 ") distributed as Fung. Fenn. No. *767*, in the Farlow Herbarium, con-

[3] In general, the specimen examined conforms to Karsten's description. However, since the spore measurements on the packet are not strictly identical with those published, it is possible that his description is based on several specimens, or on another, either from the Kola Peninsula, or from the vicinity of Turku.

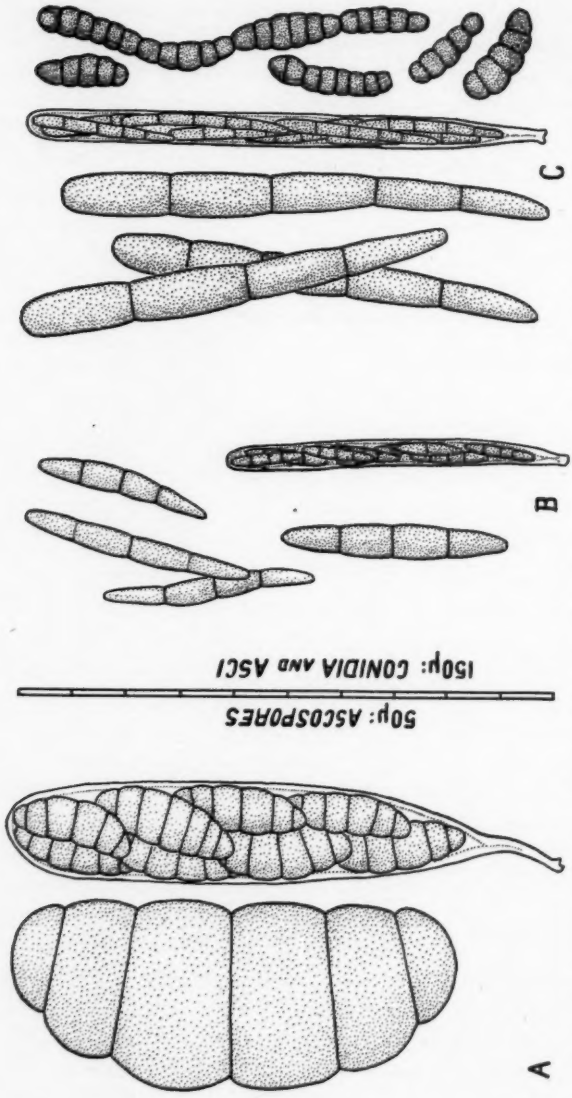

FIG. 3. *A, Hysterium dissimile* Karst. ("Ruva"); *B, Mytilidion laeviusculum* (Karst.) Sacc. (*Lophium laeviusculum* Karst. Sipilä . . . 1866"); *C, Mytilidion Karstenii* Sacc. and associated *Septonema*—("Vaasa . . . 1870").

forms to his descriptions (**6**, **7**) of *Lophium decipiens*. His specimen labelled " Tammela . . . in cort. Juniperi, 1. 29 Maji, 1869," is identical. In these hysterothecia are oblong or nearly circular, 0.25–0.3 (0.4) mm. long, flattened to slightly sunken above, with narrow crests and fragile, prosenchymatous walls. Asci are 65–80 × 7–8; enlarged toward the base. Ascospores are yellow-brown, 3-septate, (12) 15–18 (20) × 4–6, slightly constricted at the septa, fusoid but variable in shape, often a single ascus with both elongate and oblong individuals.

The species has been reported as occurring in Europe on cones of *Larix* and *Pinus*, on bark of *Pinus*, and on bark and leaves of *Juniperus*, but probably more than one species is represented by these records. Report of the fungus on bark of *Picea* in Michigan, by the writer (**13**), is incorrect.

Mytilidion decipiens (Karst.) Sacc. stands as a small-spored species inhabiting bark (and leaves?) of *Juniperus*, and possibly other conifers, with depressed-conchiform, nearly circular hysterothecia, and obclavate asci. It is similar to two needle-inhabiting species, *M. californicum* Ellis & Hark., and *M. acicolum* Wint. which has larger asci and spores, and to *M. tortile* (Schw.) Sacc., although with this species the relationship is less evident because of its vertically appressed fructifications and narrow cylindric asci (cfr. Rehm (**17**), and Bisby (**1**, p. 322, 328)).

HYSTERIUM DISSIMILE Karst. (FIG. 3*A*)

Hysterium dissimile Karst. appears to be a species of the Patellariaceae.

The specimen examined is labelled " Ruva." which, together with the descriptive notes on the packet, agrees with his description (**7**). Ascospores were found to conform closely, but asci measured larger. Giant stylospores not mentioned by Karsten were also observed.

The apothecia are black, 1–1.6 mm. in diameter, fleshy-leathery and superficial, elongate at first but circular or irregular at maturity. Hymenium and tips of asci do not blue with iodine; paraphyses are abundant, granular, simple (?), agglutinated and brown at the tips. The hypothecium is thick. Asci are thick-walled, clavate, 150–165 × 22–30, with conspicuous stalks. Ascospores and

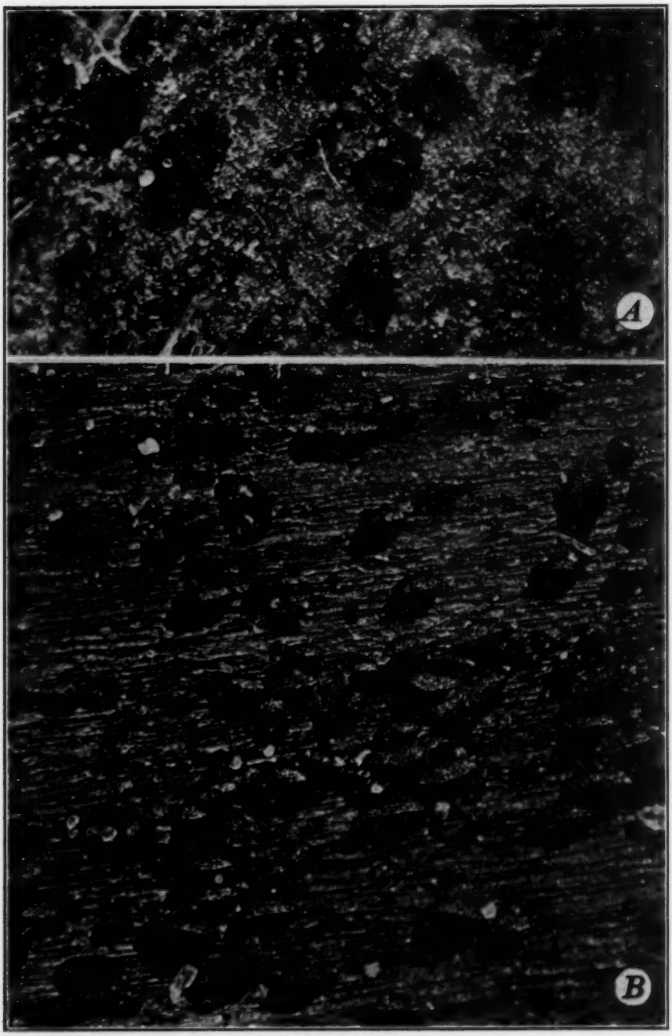

FIG. 4. *A, Mytilidion decipiens* (Karst.) Sacc. on bark of *Juniperus;* × 30 (Specimen the same as in fig. 2*E*); *B, Mytilidion laeviusculum* (Karst.) Sacc. on wood of *Pinus;* × 30 (Specimen the same as in fig. 3*B*).

stylospores are yellow-brown, elliptic, slightly curved, constricted at the septa, with rounded ends, 36–45 × 12–15, when 5- to 6-septate, and 45–52 × 12–16, when 8-septate.

In his description Karsten questions the generic position of the species; in his revision (**9**), he omits it without explanation.

LOPHIUM LAEVIUSCULUM Karst. (FIGS. 3*B*, 4*B*; and (**15**) Plate II, *B*)

Karsten's *Lophium laeviusculum* is a well-founded species now known as *Mytilidion laeviusculum* (Karst.) Sacc. It remains little known in Europe and has been recorded but once (**13**) for the United States, when collected on wood of *Larix* in Michigan.

A specimen labelled "Sipilä ad lign. fabrefact . . . pineum, 22 Maj 1866" appears to be that upon which Karsten based his distribution, Fung. Fenn. No. *771*, and may be considered the type. The fructifications, which have thin, prosenchymatous walls, are conchiform, superficial, but often seated in fissures of the wood, up 0.45 (0.5) mm. in length and 0.75 mm. in width. Asci measure 55–65 × 6–7, and the spores 16–21 × 2.5–3. No. *771* in the Farlow Herbarium is without spores.

The minute vertically appressed fructifications and small narrow-fusoid, unconstricted, yellow-brown spores of the species delimit it clearly. Its intermediate position with respect to *Bulliardella* and *Mytilidion* has been discussed (**11**, **15**).

LOPHIUM MYTILINUM (Pers.) Fries, sense of Karsten, and LOPHIUM MYTILINUM Karst. (FIG. 3*C*)

Karsten's publications (**6**, **7**, **9**) indicate the common occurrence of the fungus now known as *Mytilidion Karstenii* Sacc., on bark, wood and needles of *Pinus* throughout Finland, especially northward in Lapland in the region of Kola. The species is well defined in the literature, but with respect to the principle of type specimens it presents some difficulty.

In a specimen labelled "*Mytilidion Karstenii* Sacc. Vaasa, Julio, 1870. P. A. Karsten," the hysterothecia are superficial, swollen-conchiform, striate, 0.5 × 0.4 mm., and as high as broad. Asci are narrow cylindric, 135–150 × 8–9; ascospores 37–45 × 3.5–4,

occasionally 3- but mostly 4-septate (yet Karsten records 8-celled spores), slightly tapered toward the lower end which is often slightly curved, slightly and equally constricted at the septa, and clear yellow brown. This material is more typical of his description than is his Fung. Fenn. No. *93* in which ascospores measure 31–37 × 3.5–4, and are prominently constricted at the central septum. In the apparent absence of a specimen in the herbarium of Saccardo (Gola, **4**) and because Karsten does not mention a definite collection in his revision (**9**), it is proposed that this specimen be considered the type. The hysterothecia resemble those of *M. parvulum* Lohman; the ascospores, *M. rhenanum* Fuckel and *M. scolecosporum* Lohman, but are intermediate between these two in length.

A *Septonema,* with conidial chains rather fragmented, is associated in the specimen. This may be considered to be genetically connected, in view of a similar connection that is demonstrated culturally (**12**) for *M. scolecosporum* from Wisconsin. Conidia observed in specimens of *M. Karstenii* Sacc. collected in New England are fuscous, 3- to 5-septate with noticeable constrictions, and measure 18–30 × 6–7. In the Karsten specimen similar conidia when 3-, 4- or 5-septate measure, respectively, 18 × 6, 24 × 7.5–8, and 30 × 7–8. This stage cannot be identified with any form species already recorded on *Pinus* in northern Europe.

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EXPLANATION OF TEXT FIGURES

FIG. 1, *Gloniella ambigua* Karst., showing the *Sporidesmium* stage; × 30 ("Mustiala in ligno . . . pineo . . . 1890"); 2, *A, Gloniella ambigua* Karst.; *B. Glonium strobilarium* Karst. (*Hysterium conigenum* Karst. "Mustiala . . . 1867"); *C, Hysterium conjungens* Karst. Fung. Fenn. No. *858*; *D, Hysterium curtum* Karst. ("Soukelo ad arbor. frond . . . 1861"); *E. Mytilidion decipiens* (Karst.) Sacc. ("*Lophium decipiens* Karst . . . Tammela . . . 1869"); 3, *A, Hysterium dissimile* Karst. ("Ruva"); *B, Mytilidion laeviusculum* (Karst.) Sacc. ("*Lophium laeviusculum* Karst. Sipilä . . . 1866"); *C, Mytilidion Karstenii* Sacc. and associated *Septonema* —("Vaasa . . . 1870"); 4, *A, Mytilidion decipiens* (Karst.) Sacc. on bark of *Juniperus;* × 30 (Specimen the same as in fig. 2*E*); *B, Mytilidion laeviusculum* (Karst.) Sacc. on wood of *Pinus;* × 30 (Specimen the same as in fig. 3*B*).

NOTES AND BRIEF ARTICLES

Fungi of India

Supplement No. 1 to the above named work by Butler and Bisby has recently been published as Scientific Monograph No. 12 by the Imperial Council of Agricultural Research. The supplement is by B. B. Mundkur. New records in this work increase the total number of fungi and slime moulds from 2351 to 2868 species. One new species and six new combinations are recorded. —F. J. Seaver.

The Fungi of Manitoba and Saskatchewan

The above work has just been published by the National Research Council of Canada. The volume, consisting of 189 pages and thirteen plates, is neatly bound in cloth. It contains records of nearly 2,800 species of the fungi of those Canadian provinces, including more than thirty which are new to science, and is the work of G. R. Bisby, A. H. R. Buller, John Dearness, W. P. Fraser, R. C. Russell, and H. T. Güssow. No other credentials are necessary. In making determinations the authors have been assisted by specialists in various parts of the world. The work contains an extensive bibliography and host index. It is a decided contribution to the mycoflora of Canada.—Fred J. Seaver.

The Genus Mycena

The recent publication by Dr. Robert Kühner of Lyon, France, on the genus *Mycena* is particularly worthy of the attention of American mycologists. Dr. Kühner has not only completed a comprehensive survey of the genus from a taxonomic standpoint, but has included detailed accounts of his methods of study, the development of the fruiting body in this genus, the anatomical characters of the species and also their nuclear history in many

cases. As a result, the work is a remarkably complete biological study of the genus. It furnishes American investigators with an account of the European species based on a critical study of specimens rather than a compilation of the literature as has too often been the case in previous surveys. Kühner has wisely adapted a rather broad concept of the genus, including in it many species previously referred to such related genera as *Collybia* and *Omphalia*. This enhances the usefulness of the work immensely, but will raise certain objections, as for instance, placing *Collybia myriadophylla* in *Mycena*. Some will also disagree with Dr. Kühner on certain nomenclatorial principles, even though they admit, at the same time, that he has good reasons for his beliefs.

Since accounts of American species are also included, and placed in their positions in the structure of his classification, the work will be eminently useful as a field manual for American students.—ALEXANDER H. SMITH.

URNULA GEASTER

In a recent article on the above named species (Mycologia **29**: 60–65. *3 fig.* 1937) the writer referred to the fact that this species, described by Peck in 1893, had been frequently collected in Texas, but so far as known had not been found outside of that State. It was further stated that there seemed to be no reason why it should not occur over a wider range.

In the light of these facts it is interesting to note that in a recent article by Rokuya Imazeki (Jour. Japanese Botany **14**: 680–684. 1938) it is claimed that this species, previously known from a very restricted area in America, has now been found in Japan. The photographs and drawings indicate clearly that it is the same species. While the writer cannot read the discussion in Japanese, the summary of the article in English is as follows: " It is a matter of great interest that *Urnula Geaster* Peck was collected in Japan, last autumn. · The collector is Mr. H. Yoshii, Assistant Professor in Kyusyu Imperial University. He got only a single apothecium which was still immature and closed. This material agrees with the description given by Dr. Seaver, except the form of paraphyses, which are slender filiform as noted by Heald and Wolf. The

writer believe that this is due to the apothecium being immature."

This is only another illustration of the unusual and unpredictable distribution of many of the species of the fungi. It would be difficult indeed to account for it, and we merely accept the facts as they are.—FRED J. SEAVER.

THE GENUS SEPTOBASIDIUM [1]

A volume under this title by Dr. John N. Couch, Professor of Botany at the University of North Carolina, has recently appeared. This work was started more than ten years ago, and at that time this fungus genus was represented by about 75 species, while the present volume contains descriptions of 176 species, many of which have been described as new by the author of the work. The entire volume comprises 480 pages, 114 plates and 60 text figures.

The introduction presents a description of the life histories of some of the typical species of this genus and the account reads like a fairy story. The interesting and intimate correlation of the fungus with its insect host is almost unbelievable. All of the species of this genus are parasitic on scale insects, which in turn suck their nourishment from the plant host on which they live. The fungus appears not to be able to live without the insect on which to feed. The insect, on the other hand, is able to live but fails to prosper in isolation.

As the author points out, this is not a clear case of parasitism where the fungus lives purely at the detriment of its insect host. In return for its enforced hospitality the fungus very generously provides minute houses in which the insects live and by which they are protected from the attacks of their natural enemies. Under this arrangement, which is referred to by the author of the book as a symbiotic relationship, many of the individual insects must sacrifice themselves to the well being of the fungus, but others that are not so sacrificed receive the protection of the fungus and in turn are able to reproduce their kind and thus continue their own existence, at the same time insuring the continual existence of their fungus protector.

[1] The university of North Carolina Press, Chapel Hill.

Mycologists will find this one of the most interesting volumes that has appeared in recent times, and the author is to be congratulated on his valuable contribution to science.—F. J. SEAVER.

NOTES ON THE LIFE OF PERSOON [1]

Christian Daniel Persohn came from the island Usedom in the Baltic Sea off the coast of Pomerania. He landed at the Cape of Good Hope in 1749. He worked as a tailor. On the 21st of August 1757 he married Elizabeth Wilhelmina the daughter of Johannes Groenewald, a member of one of the old Dutch Cape families. The name was changed to Persoon. On the 31st of December 1762, their son Christiaan Hendrik Persoon was born. Four months later (May 8, 1763) the mother died. As early as 1760 Christiaan Daniel Persoon became an importer and dealer. He was moderately successful and for that time well off financially.

At the age of 13 (in 1775) Young Christiaan Daniel went to the Netherlands to begin his education. After six weeks in Amsterdam, he went to Lingen. The intention was to prepare himself so that later he could pursue a theological course. He paid 50–60 guldens for room, board and laundry at the Seminarium in Lingen.

In April 1776 young Persoon's father became seriously ill and died on the 22nd of the same month. Christiaan Hendrik Persoon inherited better than 36,000 Dutch guldens. As guardian for the boy, the father appointed the "Board for the Care of Orphans" of his city. At that time young Christiaan Hendrik's financial troubles began. His inheritance had not been paid him ten years after he became of age, due to the remissness or, as it was claimed, the dishonesty of his guardians. Fortunately the Committee for Orphans in Amsterdam kept him from actual want by advancing money which was not remitted from home on time. On the advice of a friend he gave power of attorney to two men at the Cape. Of the 10,000 guldens paid these men, by his guardians, he never received one penny.

When he was 22 (in 1784) he gave up the study of theology, because of poor health and went to Halle to study medicine. Soon

[1] A resumé of an article by J. L. M. Franken in Vol. XV, Afl. 4 of the Annale Van Die Universiteit Van Stellenbosch. (Capetown) 1937.

he went back to Lingen and was on the point of giving up his studies entirely. However, later he went to Gottingen. In 1786 he was studying at the University of Leiden, but was back in Gottingen in 1788. He remained there till the fall of 1799. In March 1799 he received the degree of Doctor of Philosophy from the "Kaiserlich-Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher." He traveled in Germany, France and Switzerland. In 1802 he went to Paris. The income from his publications was small, and he soon was suffering from extreme poverty. He lived in a small room on the sixth floor. In 1823 a friend offered to get subscriptions from friends and colleagues, but Persoon refused to even consider this. Through the intervention of Dr. Kirchhoff of Antwerp, the government of Holland gave him a pension of 800 guldens per year. In return Persoon donated his herbarium of 14,000 plants which was sent to the University of Leiden.

In 1834 (only two years before his death) he was visited by Franz Junghuhn, the Humboldt of Java, with an offer to go to Java. He was startled to see a shrunken little man, with gray hair and a tangled beard. His eyes were watery, inflamed and blinking. This was the prince of mycologists, who lived then at No. 2 Rue des Charbonniers, in the neighborhood of the present Gare de Lyon. In the cemetery Le Père Lachaise is a worn tombstone with the inscription:

PERSOON
CHRETIEN HENRY
Botaniste

Né au cap de Bonne Espérance
Décédé le 15 Novembre 18—

To quote Fee: "Thus lived and died perhaps the greatest genius Mycology has ever known, for Persoon was a builder. He began the work with practically nothing and left a system of which others have availed themselves with much too little acknowledgement."—RICHARD DE ZEEUW.

MYCOLOGICAL SOCIETY OF AMERICA

SUMMER FORAY

The Mycological Foray will be held in the Great Smoky Mountain National Park, but with headquarters at Gatlinburg, Tennessee. In view of the fact that the meetings will be held from August 17th to 20th inclusive, during the tourist season, it is advisable that those planning to attend make reservations early at one of the following places, all within the radius of a mile:

Mountain View Hotel	$4.00 up	AM*
Riverside Hotel	3.00 up	AM
Leconte View Lodge	1.50	EM
Smoky Heights Resort	1.00 up	EM
Gateway Tourist Cabins	1.25 up	E
Water Cress Cabins	1.50 up	E
Reagan's Cabins	1.00	E
Laurel Springs	1.00 up	E
King Cabins	1.00 up	E
Huff's Tourist Cabins	1.25 up	E
Dewey Ogle's Cabins	1.00	E
Ross Moore Tourist Home	1.00 up	E
M. & O. Tea Room	1.00 up	EAM
Indian Gap Hotel and Cabins	2.00 up	A
Maples Manor Hotel	no information as is new	

Because of the great differences in elevation, 5,800 feet between lowest and highest elevations, and because of the richness of the flora, the region should be of intense interest to those desiring to collect, and of equal interest to those who enjoy mountain scenery. Furthermore, it is reported that some of the best trout fishing in the east is to be found here, and it is urged that those who desire to follow this sport first obtain fishing regulations from the Park Superintendent at Gatlinburg.

Gatlinburg may be reached via routes U. S. 19, N. C. 107, and Tenn. 71 from Asheville, North Carolina, and by way of Tenn. 71 from Knoxville, Tennessee. Additional road information may be obtained from maps furnished by the larger oil companies. The Louisville & Nashville and the Southern Railways serve Knoxville and the latter railroad also Nashville, and from these two places Gatlinburg is reached by bus.—DAVID H. LINDER.

*A: American plan; E: European plan; M: meals served.